TFW-AM 10-91-002

WATERSHED CHARACTERISTICS AND CONDITIONS INVENTORY

TANEUM CREEK AND TACOMA CREEK WATERSHEDS

By

Jones and Stokes Associates

TIMBER FISH & WILDLIFE

JUNE 28, 1991

Watershed Characteristics and Conditions Inventory

Taneum Creek and Tacoma Creek Watersheds

Prepared for:

Department of Natural Resources
Forest Regulations and Assistance
1007 S. Washington, MS: EL-03
Olympia, WA 98504
(206) 753-5315

Prepared by:

Jones & Stokes Associates
2820 Northup Way, Suite 100
Bellevue, WA 98004
(206) 822-1077

June 28, 1991

Table of Contents

List of Figures

List of Tables

Group D. Eastern Washington

INTRODUCTION

The Ambient Monitoring Steering Committee (AMSC) of the Timber/Fish/Wildlife (TFW) Cooperative Monitoring, Evaluation and Research Committee (CMER) has contracted with Jones & Stokes Associates to conduct a Watershed Characteristics and Conditions Inventory (WCCI) on six watersheds within the state. The goal of the project is to provide information necessary to interpret the influence of watershed conditions on the characteristics of stream channels. This WCCI has involved the collection and compilation of information related to the natural characteristics and management-affected conditions of the designated watersheds. Stream surveys have previously been completed by AMSC trained crews on all or portions of the streams within these watersheds.

The six watersheds have been divided into three groups: West Slope Cascade Mountains, Olympic Peninsula, and Eastern Washington. This report presents the results of the WCCI for the Eastern Washington Group, consisting of Taneum Creek and Tacoma Creek watersheds.

Part 1 of this report describes the methods of data collection and results of the inventory for Taneum Creek watershed; Part 2 presents this information for Tacoma Creek. Part 3 consists of a comparative summary and conclusions regarding the inherent stability and harvest intensity within the study areas. A series of l:24,000-scale maps and overlays, with attributes described on Dbase data files, accompanies this report.

PART 1. TANEUM CREEK WATERSHED

The Taneum Creek watershed is located approximately 10 miles northwest of Ellensburg on the eastern slope of the Cascade Mountains. The 82.9-square mile watershed lies.within Sections 1 through 4 and 11 and 12 of Township 18 North, Range 14 East; Sections 1 through 12 of Township 18 North, Range 15 East; Sections I through 17 of Township 18 North, Range 16 East; Sections 3 through 9 of Township 18 North, Range 17 East; Sections 24 and 25 of Township 19 North, Range 13 East; Sectiorts 13 through 17 and 19 through 36 of Township 19 North, Range 14 East; Sections 13 through 36 of Township 19 North, Range 15 East; Sections 19 through 21 and 27 through 36 of Township 19 North, Range 16 East, and Sections 29 through 34 of Township 19 North, Range 17 East. Taneum Creek is a tributary to the Yakima River.

Methods

Watershed Characteristics

Climate

Elevation. The Taneum Creek watershed boundary was delineated on the Thorp, Taneum Canyon, Frost Mountain, Quartz Mountain, Mt. Clifty, Easton, Ronald, Cle Elum, and Teanaway United States Geologic Survey (USGS) $7^{1/2}$ minute topographic maps. Basin relief was calculated by determining the difference in elevation between the basin mouth and the highest point on the watershed divide. Mean elevation was determined by measuring the area of the entire watershed with a Planix planimeter, then measuring the area above mid-basin contours. The mean elevation is the contour elevation above which 50% of the watershed area is located.

Precipitation. Precipitation information was obtained from USGS Climatedata disks. The disks were searched to locate weather stations within 20 miles of Taneum Creek that represent the range of elevations within the watershed. Two stations were selected: Ellensburg at 1,480 feet and Bumping Lake at 3,440 feet. A summary of average monthly and annual precipitation and snowfall for these stations is included in Appendix A.

Average monthly precipitation and snowfall data from the two stations was weighted on an area basis to determine monthly precipitation for the Taneum Creek watershed. The area weighting was accomplished by drawing lines along the contour elevations halfway between the elevations represented by each station. Each station was assumed to represent the watershed area within these lines. The area represented by each station was measured with a Planix planimeter. A weighting factor was then assigned based on the percent of the watershed area represented by each station.

The 2-year, 24-hour precipitation event for the watershed was determined by consulting the National Oceanic and Atmospheric Administration (NOAA) Precipitation Frequency Atlas (1970). The 2-year, 24-hour precipitation for the basin is the average of the six isopluvials which cross the basin.

Air Temperature. Air temperature information was obtained from the USGS Climatedata disk. Because daily temperature values were not available, average monthly values were used. Average monthly maximum and minimum temperatures for Ellensburg and Bumping Lake were weighted on an area basis in the same manner as the precipitation data to determine temperatures for the Taneum Creek watershed. A summary of temperature information for the three stations is included in Appendix A.

Water Temperature. Local land managers and the Yakima Indian Tribe were contacted for information regarding water temperature in Taneum Creek.

Geology. The Geologic Map of the Wenatchee 1:100,000 Quadrangle, Central Washington (Tabor et al. 1982) and Geologic Map of Washington - Southwest Quadrant

(Walsh et aL 1987 - original scale 1:250,000) were reproduced at a scale of 1:24,000 to construct the Geology Overlay of the watershed. The mapping unit boundaries displayed on the Geology Overla5 should be viewed with the original scale of these maps in mind. The Geology Overlay merely provides a general characterization of the underlying geology of the watershed, as opposed to a detailed geologic investigation.

Soils. The Soils Overlay was constructed using the State Soil Survey Township Soils Maps (original scale 1:24,000). Information from the State Soil Survey Report for the Yakima River district of the Southeast area (WDNR 1975) was then incorporated into a Dbase database. The database includes acreage of each mapping unit, soil name, natural and disturbed stability ratings, road*related erosion hazard, timber harvest-related erosion hazard, and site index. These parameters are explained in the database description included in Appendix C.

Hydrology

Drainage Network and Basin Dimensions. Stream orders were completed for the watershed using the standard method developed by Strahler (1964). Unbranched, blue-line tributaries are designated as first-order streams on the 1:24,000 scale USGS topographic base maps. Second-order streams are designated where two first-order streams flow together, and third-order streams are designated when two second-order streams join. Drainage density was computed by measuring the total length of streams in each order and dividing by the watershed area.

Watershed area was measured with a Planix planimeter. The fifth-order watershed was divided into five third-order subbasins. Basin length was measured from the mouth to tile drainage divide following the main channel. Basin width was measured at the midpoint of the channel, perpendicular to the direction of flow. Relief ratio was calculated as basin relief divided by the length of the basin (Dunne and Leopold 1974).

Flow. The Bureau of Reclamation installed a gage on Taneum Creek in 1989 (Perala pers. comm.). The location of the gage is shown on the Miscellaneous Features Overlay. Due to the short period of record and lack of a rating curve for this new gage, it was necessary to use two nearby gaged streams to estimate characteristic flows for Taneum Creek.

Manastash Creek is the drainage immediately to the south of Taneum Creek. Climate, geology, topography, and basin area of Manastash Creek is quite similar to Taneum Creek. Unfortunately, streamflow was only measured on the mainstem from 1909 to 1914, a relatively short period of record on which to base estimations for an ungaged basin. Naneum Creek, to the east of Taneum Creek, has a longer period of record, with data available from 1957 through 1978, and similar basin area size. However, Naneum Creek drains the eastern portion of the Wenatchee Mountains and receives less precipitation than the Taneum watershed. A summary of the gaging data for these two stations is provided in Appendix A.

Despite the difference in annual precipitation input, both Naneum and Manastash Creeks have an average annual runoff of 0.8 cubic feet per second (cfs) per square mile. Average annual flow for Taneum Creek was estimated by multiplying the Taneum Creek basin area by 0.8 cfs per square mile.

The Naneum Creek gaging data shows only a weak influence from snowmelt runoff and does not represent the seasonal variability of precipitation and runoff likely to occur in Taneum Creek. Therefore, despite the short period of record, the Manastash Creek data was used to estimate the magnitude of monthly flows in Taneum Creek. Monthly flows for Taneum Creek were estimated by calculating the ratio of monthly to average annual flows for Manastash Creek and multiplying by the estimated average annual flow for Taneum Creek. Maximum, mean, and minimum monthly flow estimates were generated by multiplying the calculated ratios by the estimated average annual flow for Taneum Creek. One standard deviation above and below the mean was also calculated to display the flow variability. This method of developing ratios of monthly flows to estimate flow in an ungaged watershed was tested by Amerman and Orsborn (1987). Three discharge measurements taken by the Bureau of Reclamation at their gaging station were used to check the estimated monthly flows.

The 5-year period of record on Manastash Creek is inadequate for calculation of the 2-year flood flow and 20-year low flow necessary to develop a flow duration curve for Taneum Creek. Therefore, Naneum Creek gaging data, measured over a 21-year period of record, was used to estimate these characteristic flow events in Taneum Creek.

Daily flows for Naneum Creek were ordered from lowest to highest. The low flow with a 0.05 probability (20-year recurrence interval) and high flow with a 0.5 probability (2-year recurrence interval) were then determined. The ratio of these characteristic flows to the average annual flow of Naneum Creek was then calculated. The 1-day, 20-year average low flow (Q1L20), and l-day, 2-year average flood flow (Q1F2) were then estimated for Taneum Creek by multiplying the average annual flow in Taneum Creek by the Naneum Creek ratios. A flow duration curve was developed by assuming that Q1F2 is exceeded 0% of the time, QAA is exceeded 32% of the time, and Q1L20 is exceeded 100% of the time.

Existing Studies. Local land managers, the Washington Department of Ecology (WDOE), Yakima Indian Tribe and Cle Elum Ranger District of the Wenatchee National Forest were contacted to determine whether any instream flow or other pertinent studies have been conducted on Taneum Creek.

Geomorphology

Slope Classes. The watershed was stratified into slope classes based on the spacing of contour lines on 7 1/2 minute USGS maps. Slope classes were: 0% to 5%; 5% to 30%; 30% to 65%; 65% to 90% and greater than 90%. A key was developed which depicted the 40-foot contour interval for 5%, 30%, 65%, and 90% slopes. The Slope Class Overlay was manually constructed by moving the key around on the map to visually identify the acreage in each slope class. The minimum size of the delineated areas is 5 acres.

Channel Profile. A channel profile of the mainstem was constructed by measuring the length of the channel between each 40-foot contour line on the USGS 7 $^{1}/_{2}$ minute topographic map. Channel slope was then calculated by dividing the rise in elevation by the channel distance. Channel slope was calculated for each valley segment type, as described in the following section.

Valley Segments. Valley segments were identified using the methodology developed by Cupp (1989). Valley segments identified during the AMSC/Northwest Indian Fisheries Commission (NWIFC) stream survey of 1989 and 1990 were verified using the channel profile, Slope Class Overlay, 1985 l:12,00-scale aerial photos, and field reviews on April 23 and 27, 1991.

Watershed Conditions

Vegetation

Dominant Species and Timber Harvest Intensity. Major landowners within the Taneum Creek watershed were contacted to obtain timber stand species composition, age, and stand density. The Washington Department of Wildlife (WDW), U.S. Forest Service (USFS), and Plum Creek Timber Company, Inc. supplied information on vegetation w/thin the watershed.

The lower portion of the watershed is part of the L.T. Murray Wildlife Recreation Area, managed by the WDW to provide habitat for elk. The WDW supplied maps from their GIS system Habitat Cover Inventory. Cover types were delineated using LANDSAT TM imagery taken in July 1986. Cover type categories were designed to evaluate habitat for elk and were based on percent canopy closure and type of forage available. Information on tree species, age and stand density was not available.

Cover type categories on the 1:50,400 scale maps supplied by the WDW were transferred to 1:24,000 scale maps using a combination of the LANDSAT TM imagery and interpretation of 1985 1:12,000 scale aerial photos. Cover type categories included four categories of forage, open and closed conifer stands, woodlands, and deciduous vegetation. The forage categories were lumped into one classification since the distinction between different grass and shrub communities is not relevant to the purposes of this inventory. Agricultural lands, rock outcrops, and open water were also identified.

The primary land owner in the upper watershed is the USFS. The Cle Elum Ranger District of the Wenatchee National Forest supplied vegetation condition information on 1:24,000 scale maps produced by a GIS system database. Vegetation condition classes are based on tree height and crown closure as well as management history of the stand. More specific information regarding tree species, year of origin, and stand density is not currently available for the district. The "Oracle" database being developed on the Cle Elum Ranger District will pro,ride this information for managed stands in the near future.

The Wenatchee National Forest database includes vegetation condition information for intermingled private ownership within the upper Taneum Creek watershed. Therefore, the USFS condition classes were used to describe vegetation on private lands in the upper watershed. Plum Creek Timber Company provided timber stand inventory maps and data which were used to update the USFS information.

Vegetation information for 9% of the watershed, where residential and agricultural land uses occur, was interpreted from 1985 1:12,000 scale aerial photos. Vegetation was classified according to WDW cover type.

The Vegetation Overlays consist of a series of numbered ceils which are keyed to a Dbase database that contains information on cell acreage and vegetation condition (WDW cover type in the lower watershed; USFS condition class in the upper watershed). The acreage of the stands reported in the database is the gross acres. "Ribbon acres" of roads within the stands have not been subtracted out.

Also included in the database is locational information, including water resource inventory area (WRIA), subwatershed, legal description, ownership, and the original identification number assigned by the landowner. The comments section in the database identifies stands for which vegetation information was interpreted from aerial photos.

Dominant tree species is not included in either the WDW or USFS database and, therefore, this information is not included in the vegetation database. An estimate of dominant tree species within the watershed was obtained from local land managers.

Riparian Condition. The condition of riparian vegetation along the mainstem of Taneum Creek was given special scrutiny during this inventory. Dominant riparian tree species were noted during the April 23 and 27 field reviews.

Riparian vegetation condition was determined for the entire length of the mainstem and North and South Forks using 1985 aerial photos in combination with information supplied by the landowners. The length of stream corridor occupied by a given stand was measured on the Vegetation Overlay and recorded in the riparian database. Stream corridors which had different stand conditions on either bank were assigned half of the total stream length to each stand. Appendix D contains a complete description of the riparian database.

Disturbance History

Roads. Road locations in the watershed were determined using 1:12,000 scale 1985 aerial photos and maps supplied by landowners. The Road Overlay displays the location of roads according to four classes: interstate highway, main paved or gravel-surfaced, arterial gravel-surfaced; and temporary spurs. Road lengths in each class were measured; road density was calculated as the length of road (in miles) divided by the watershed area (in square miles).

Mass Wasting. Active landslides were inventoried using 1985 aerial photos and field reviews on April 23 and 27, 1991.

Fires, Floods, and Other Disturbances. Local land managers and the Yakima Indian Tribe were contacted to obtain information on past disturbances, including fires and floods.

Land and Water Use

Dams, Mining, Etc. Field investigation and aerial photos were used to check for past or active dams and mining activities affecting the basin. Gravel pit locations were determined through aerial photo interpretation and included in the Vegetation Overlay and database.

Miscellaneous Features. The location of lakes and wetlands was identified from 1985 1:12,000 scale aerial photos and included on the Vegetation Overlays and database.

Results

Watershed Characteristics

Climate

Elevation. Mean elevation of the basin is 4,000 feet. Elevation ranges from 1,690 feet where Taneum Creek enters the Yakima River to 6,280 feet on Quartz Mountain. Net relief is 4,590 feet.

Precipitation. Monthly precipitation and depth of snowfall is presented in Table 1 and Figure 1. Average annual precipitation for the watershed is 36.2 inches and average annual depth of snowfall is 171.0 inches. The snowfall depth does not reflect actual accumulation of the snowpack on the ground but, rather, the sum of individual snowfall events.

Air Temperature. Average maximum and minimum monthly temperatures are presented in Table 1 and Figure :2. The average annual maximum temperature is 55°F and the average annual minimum temperature is 30°F.

Water Temperature. The Washington Department of Natural Resources (WDNR) and Yakima Indian Tribe have monitored stream temperatures within the watershed. Temperatures greater than the maximum of 16.3°C specified in the State of Washington Water Quality Standards were occasionally measured in the mainstem, while no violations have occurred in the North Fork (Bambrick pers. comm.).

Table 1, Taneum Creek Watershed Climatic Data Summary

	Jan	Feb	Mar	Apt	May	June	July	Aug	Sep	Oct	Nov	Dec	Annual
Total Precipitation (inches)	5.8	4.4	3.5	1.8	1.5	1.3	0.5	0.6	1.2	3.1	5.5	6.9	36.2
Snowfall Depth	45.4	30.5	25.1	6.4	2.6	0.0	0.0	0.0	0.1	2.4	19.6	37.9	171.0
Minimum Temperature (degrees F)	33	39	45	54	62	68	77	77	70	59	43	35	55
Minimum Temperature	15	I8	22	28	35	41	45	44	38	31	24	20	30

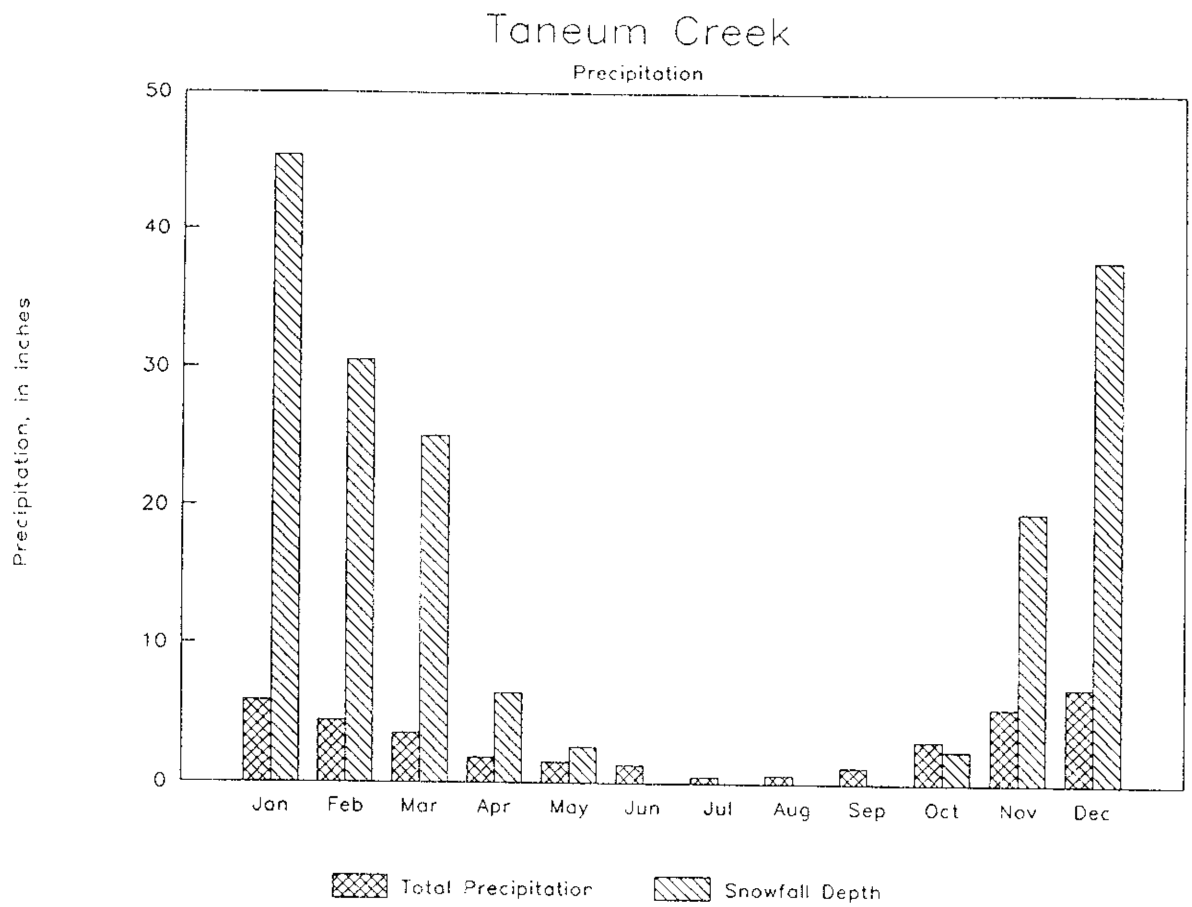

Figure 1. Estimated Average Monthly Precipitation for Taneum Creek Watershed.

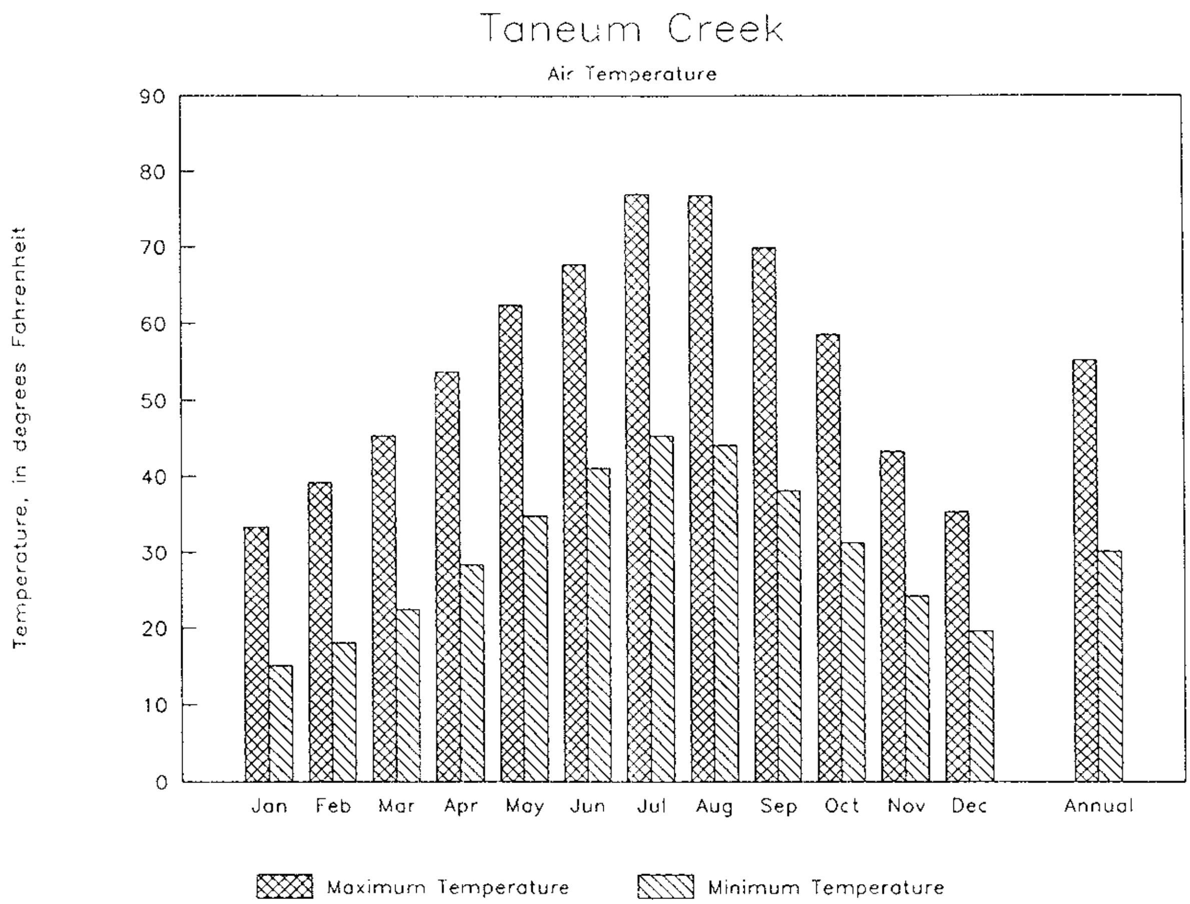

Figure 2. Estimated Monthly Air Temperatures for the Taneum Creek Watershed

Geology. Table 2 displays the geologic makeup of the watershed as described by Tabor et al. (1982) and Walsh et al. (1987). The majority of the watershed is underlain by rocks of volcanic origin dating to the Eocence through Miocene ages. The upper slopes and ridgetops are underlain by relatively erosion-resistant basalt and andesite flows which overlie Jurassic and pre-Jurassic-age phylitte and schist. These much older, metamorphized formations have been isoclinally folded into broad valleys and gentle ridges. The metamorphic rock is exposed in a wide band stretching from the southeastern portion of the South Fork valley, along the North Fork and across the north and west watershed divide.

Alluvial deposits blanket the mainstem valley bottom and the flatlands near the mouth, where Taneum Creek enters the Yakima River valley. Poorly sorted colluvial deposits from ancient and active landslides mantle the lower valley sideslopes. These landslide deposits are frequently located downslope of exposed sedimentary rock of the Ellensburg formation (mapping symbol Tev). The Ellensburg formation consists of sandstone, siltstone, and volcaniclastic debris deposited by rivers draining the east slope of the Cascade Mountains during the early Miocene age.

Soils. The Soils Overlay and database display the location and properties of soils within the watershed. Soils information was not available for 3,433 acres (6%) in the lower portion of the watershed.

In an undisturbed state, 79% of the watershed contains soils rated as stable and 10% of the watershed contains unstable soils (Table 3). However, after disturbance by road construction or landings and/or by timber harvesting, the soils on only 38% of the watershed are rated as stable, while 51% of the watershed contains unstable or very unstable soils.

The hazard for accelerated erosion of cut slopes, fill slopes, or sidecast material is rated as slight on 8,849 acres (17%), moderate on 29,057 acres (55%) and severe on 9,360 acres (18%). Area unsuitable for road construction amounts to 772 acres. The timber harvest-related erosion potential is rated as low on 1,168 acres (2%), medium on 14,491 acres (27%) and high on 29,275 acres (55%). Area unsuitable for timber harvest amounts to 3,104 acres (6%). These ratings have been developed by the WDNR (1974) for the Yakima district of the Southeast Area. They are explained in more detail in Appendix C.

Site index classes for the watershed are displayed in Table 4. Site index is a designation of the quality of a forest site based on the height of the tallest trees in a stand at 50 or 100 years of age. The site index for the majority of the watershed applies to Douglas-fir *(Pseudotsuga menziesii)* stands and ranges from 60 to 121, with an average of 84.

Hydrology

Drainage Network and Basin Dimensions. Taneum Creek is a fifth-order stream with a watershed area of 53,057 acres. Two overlays were constructed to display the watershed boundaries and stream orders. The watershed contains 85.7 miles of first-order streams, 35.5 miles of second-order streams, 6.7 miles of third order-streams, 9.6 miles of fourth-order streams, and 12.8 miles of fifth-order stream. Drainage density for the 82.9 square-mile watershed is 1.8 miles per square mile.

Table 2. Geologic Mapping Units within the Taneum Creek Watershed

Unit/Symbol	Description	General Category	Acres	% of Watershed
Qa, Olbm, Olbs, Qf, Qkim, Os	Alluvium	Unconsolidated	2,054	4
()ls	Landslide deposits	Unconsolidated	8,750	16
Qb	Bog deposits	Unconsolidated	31	--
Qksm, Qkst	Outwash and till	Unconsididated	1,218	2
Tim	Thorp gravel	Unconsolidated	774	1
Tgn2, Tgr2, Tbf, Evb	Basalt flows	Volcanic rock	17,468	33
Tev, Tm, Ec	Sandstone, siltstone conglomerate	Sedimentary rock	3,792	7
Tta, Eva	Andesite flows	Volcanic rock	6,579	12
Tdg, Eib, Evr	Intrusive diabase, gabbro, basalt	Volcanic rock	1,661	3
Jog, Jsh, Jph	Orthogneiss, Schist, Phyllite	Metamorphic rock	2,199	4
p Jam, pJsc, pJmp	Amphibolite, Schist, Phyllite	Metamorphic rock	8,252	16
Tz	Tectonic zone	'--	279	1

Table 3. Soil Stability Characteristics within the Taneum Creek Watershed

Condition	Natural Stability	Disturbed Stability
Stable	41,673 (79)	20,007 (38)
Unstable	5,593 (10)	21,227 (40)
Very Unstable	0 (0)	6,032 (11)
Not Rated[1]	5,791 (11)	

Includes rock outcrops, lakes, and 3,433 acres at the mouth of the watershed where the soil survey has not been completed.

Note: Expressed in acres and percent of watershed area. Ratings are from the State Soil Survey Report for the Yakima River District of the Southeast Area (WADNR, 1975).

Table 4. Site Index for Taneum Creek Watershed

Index Species	Site Index	Acres	% of Watershed
Douglas-fir	60 to 79	20,938	39
	80 to 99	16,029	30
	100 to 199	3,601	7
	100 +	1,370	3
Ponderosa pine	60 to 99	526	1
	100 to 109	211	
Mountain hemlock	40	25	
Subalpine fir	50 to 69	2,009	4
Not rated[1]		8,348	16

Includes non-forested lands and 3,433 acres in the lower watershed where data was not available.

The watershed has an eastward orientation. Basin length is 107,500 feet and basin width is 25,500 feet. The relief ratio is 0.04.

Flow. As described in the Methods section, streamfiow data for the basin was estimated using gaging data from nearby Manastash and Naneum Creeks. Appendix A contains a summary of the gaging data for these stations.

Estimated monthly streamflow for Taneum Creek is provided in Table 5 and Figure 3. Highest flows occur during March through June in response to snowmelt runoff. March runoff exhibits particularly high variability. Lowest flows occur from August through October.

The Bureau of Reclamation provided three discharge measurements taken near the Taneum Guard Station in 1989 and 1990. Measured streamfiow was 6.24 cfs on October 18, 1989; 13.9 cfs on January 4, 1990; and 46.0 cfs on August 21, 1990. The October and January measurements indicate that the calculated average monthly flows provide a reasonable estimate of streamflow in Taneum Creek. The August measurement is much higher than the calculated average monthly flow for August, but the discharge measurement notes indicate that it was raining at the time of the measurement.

Average annual flow is estimated at 66 cfs. This translates to an average annual runoff of 0.8 cfs per square mile. The 2-year flood flow was estimated to be 508 cfs. Figure 4 displays the flow duration curve developed for Taneum Creek.

Water is diverted from Taneum Creek near the mouth and downstream of the L.T. Murray Wildlife Recreation Area. The diversion is part of a Bureau of Reclamation Project involving the upper Yakima River basin.

Existing Studies. Stream surveys were conducted on the South Fork Taneum Creek in the summer of 1989 and on the North Fork in 1990. The Northwest Indian Fisheries Commission crews collected information on habitat unit distribution, channel substrate, habitat modifiers, and riparian vegetation according to a procedure described in the TFW Stream Ambient Monitoring Field Manual (Ralph 1989).

The mainstem of Taneum Creek from the Thorp Road to the forks was also surveyed as part of another TFW project. Riparian vegetation and landslide initiation areas are being documented, in addition to the stream channel parameters described above. (Smith pets. comm.)

The VDOE has funded a project to conduct an analysis of fine sediment and dissolved oxygen in spawning gravels of the upper Yakima River Basin. The Washington Department of Fisheries sampled sediment in riffle units within the North Fork and mainstem of Taneum Creek. (McKinney pers. comm.)

Sediment samples taken by the Yakima Indian tribe yielded 15% to 23% fines (particles less than 1 mm) on the North Fork and 10% to 20% on the mainstem. This level of fine sediment is w/thin a "yellow light" threshold of concern, according to Dale Bambrick,

Table 5. Estimated Monthly Flows for Taneum Creek, Based on Manastash Creek Gaging Data

	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Year
D Max	22	268	124	70	62	98I	508	457	437	97	39	119	98t
+ 1 s.d.	16	42	34	39	34	236	225	265	179	49	20	16	87
D Avg	14	26	22	27	26	1t2	149	193	124	37	17	14	66
-1 s.d.	11	11	I0	15	I7	-11	74	I2t	70	26	15	13	45
D Min	9	10	8	11	10	14	34	73	45	i8	7	8	7

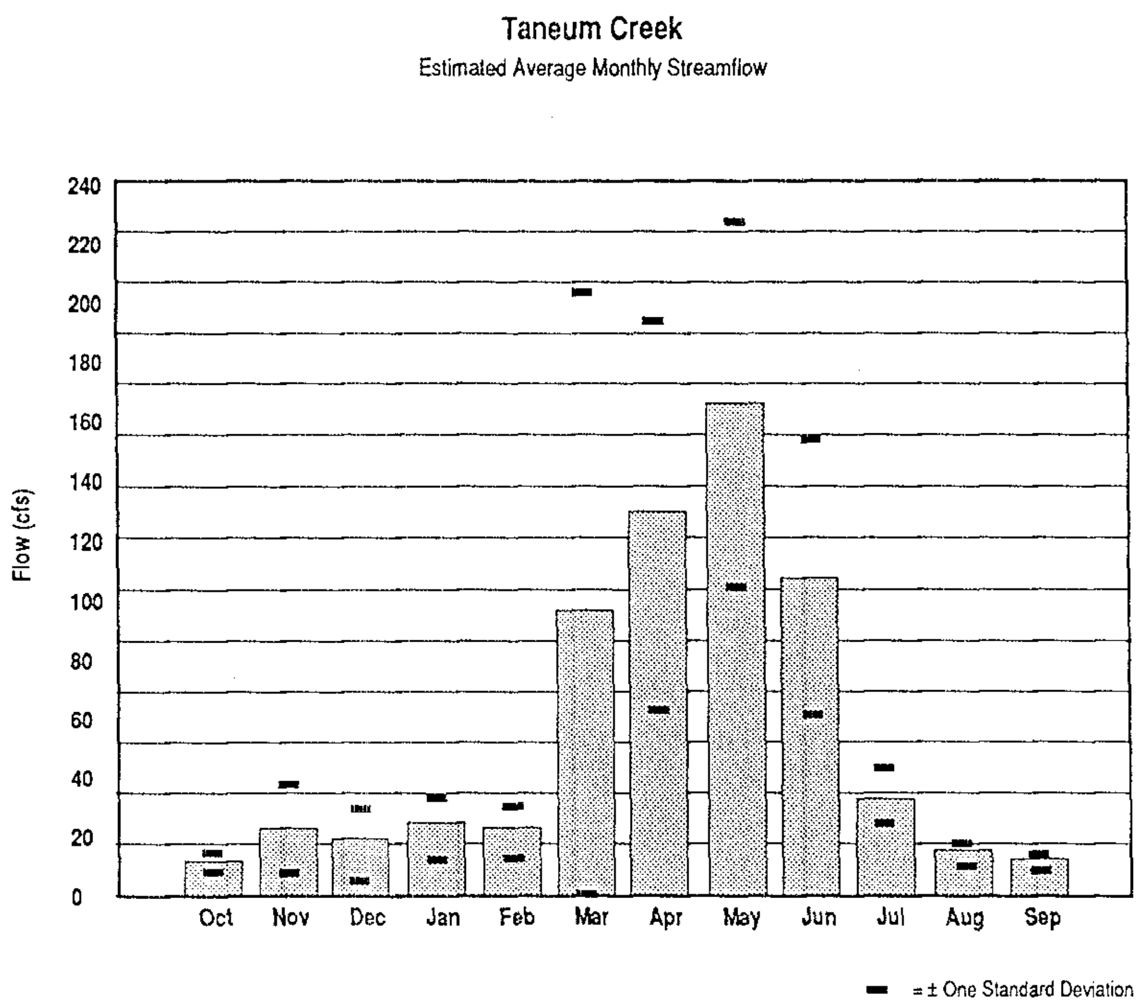

Figure 3. Estimated Average Monthly Streamflow in Taneum Creek

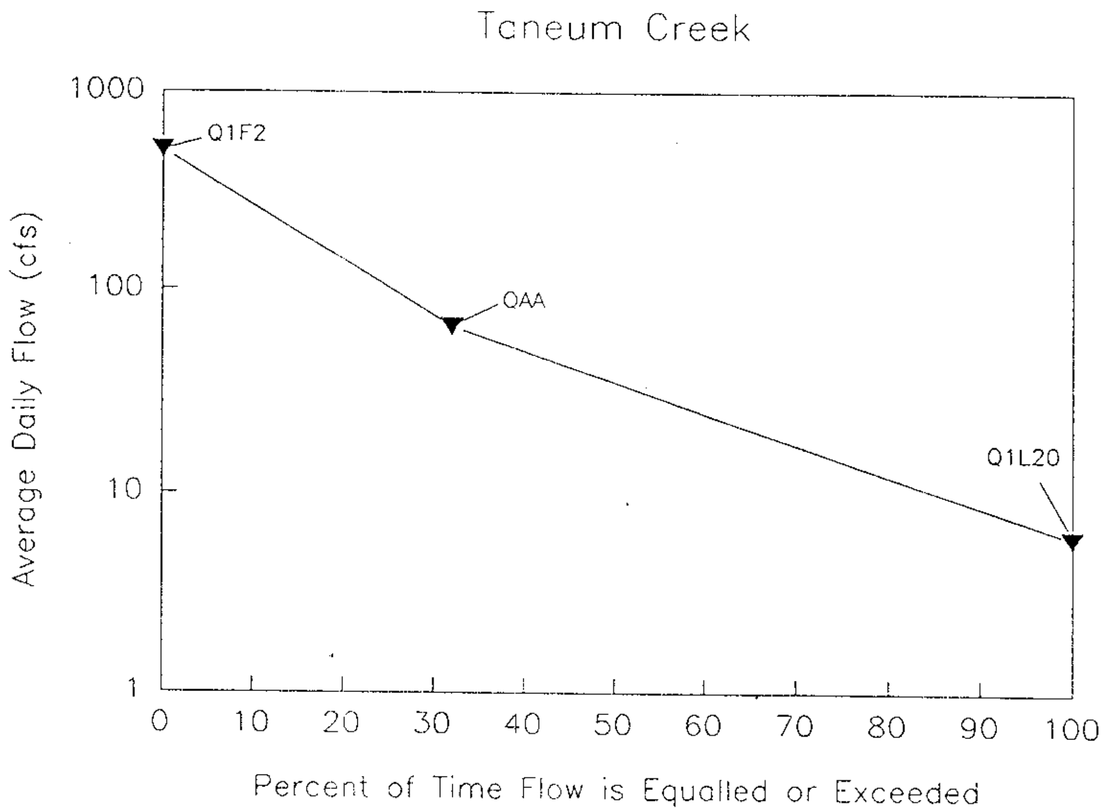

Figure 4. Estimated Flow duration Curve for Taneum Creek

fisheries biologist with the Yakima Indian Tribe. The highest concentrations of sediment were found in the upper reaches of the North Fork, which correspond with the highest intensity of timber harvest activities. Further investigations are necessary to better understand sediment levels in the system. (Bambrick pers. comm.)

Information on the entire Yakima River basin is being compiled into a GIS system database at Central Washington University. The project involves compilation of vegetation information as part of the Yakirna River Resource Management Plan. (Owens pers. comm.)

The WDNR installed a weir downstream of the ford at the Taneum Creek campground. Water level behind the weir and stream temperature were measured on a daily basis from 1987 through 1990. Data analysis has not yet been completed. (Berndt pers. comm.)

Geomorphology

Slope Classes. The Slope Overlay displays the distribution of slope classes in the watershed. Table 6 lists the acreage of land in the slope classes. Thirty five percent of the watershed has gentle slopes under 30%. The majority of the watershed has moderately steep slopes between 30% and 65%, and only 1% of the basin includes steep slopes greater than 65%.

Channel Profile. The channel profile is displayed in Figure 5. Data used to develop the profile are contained in Appendix B. A typical pattern of increasing slope from mouth to headwaters is exhibited by the channel.

Valley Segments. The distribution of valley segment types on the mainstem, North Fork, and South Fork is shown on the Valley Segment Overlay. Table 7 describes the extent and slope of each valley segment type on the mainstem. For a complete explanation of valley segment characteristics see Cupp (1989).

The major valley forming process has been dominated by fluvial, rather than glacial, activity. The lower 3 miles of Taneum Creek meanders across a broad, flat alluviated valley (F3) bounded by isoclinally uplifted ridges. The valley bottom width is greater than five times the active channel width in this low gradient, highly meandered segment.

The valley bottom gradually narrows in an upstream direction as the stream enters Taneum Canyon. Above river mile (RM) 3.1 the valley is bounded by moderately steep (30% to 65%) sideslopes. In this alluviated mountain valley (V4) segment, deposition of sediments eroded from the upper watershed has resulted in a flat valley bottom within the V-shaped valley. Above the V4 segment, the channel is tightly bounded by steep slopes (V1) up to the junction of the North and South Forks.

The North Fork of Taneum Creek is bounded by steep slopes throughout the lower 9.9 miles. The valley bottom width alternates between tightly confined (V1) and slightly greater than two times the active channel width (V4). Valley bottom gradient varies from 1% to 3%. Above RM 9.9, the valley cross sectional shape changes from a fluvial

Table 6. Slope Classes within the Taneum Creek Watershed

Slope Class	Acres	% of Watershed
0 to 5%	1,663	3
5 to 30%	16,970	32
30 to 65%	34,012	64
65 to 90%	393	1
> 90%	19	

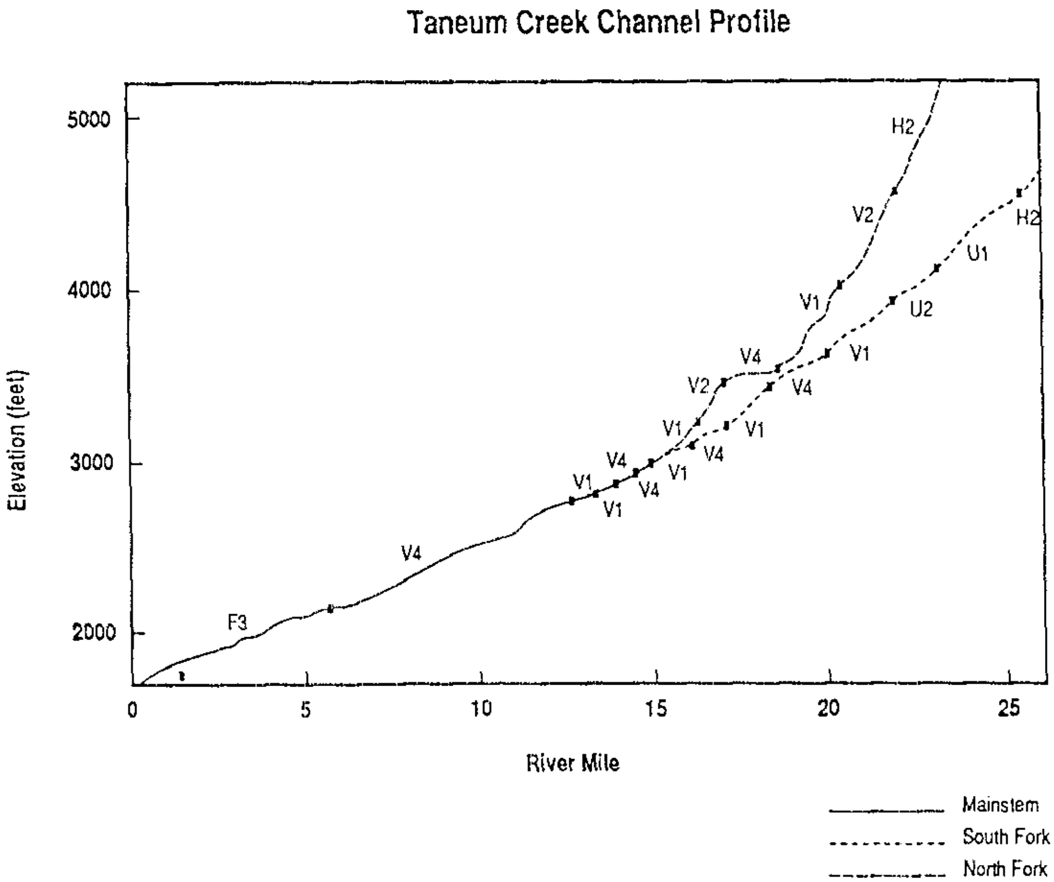

Figure 5. Taneum Creek Channel Profile and Valley Segment Types

Table 7. Valley Segments on the Mainstem,
North Fork, and South Fork of Taneum Creek

Segment[1]	Extent (River Mile)	Channel Slope
Mainstem:		
F3	0 to 6.1	1%
V4	6.1 to 13.0	2%
V1	13.0 to 13.3	2%
North Fork:		
V1	0 to 1.1	2%
V4	1.1 to 1.6	1%
V1	1.6 to 2.8	2%
V4	2.8 to 4.1	1%
V1	4.1 to 5.7	3%
V4	5.7 to 7.8	2%
V1	7.8 to 9.9	3%
U2	9.9 to 10.9	4%
U1	10.9 to 12.4	3%
H2	12.4 to 12.5	11%
South Fork:		
V4	0 to 1.7	2%
V1	1.7 to 2.6	3%
V2	2.6 to 3.6	6%
V4	3.6 to 5.1	1%
V1	5.1 to 7.1	5%
V2	7.1 to 7.9	6%
H2	7.9 to 8.9	9%

F3 Wide mainstem valley
V1 V-shaped, moderate gradient bottom
V2 V-shaped, high gradient bottom
V4 Alluviated mountain valley
U1 U-shaped trough
U2 Incised U-shaped valley, moderate gradient
H2 High gradient valley wall tributary

dominated V-shaped to glacial dominated U-shaped. In the U2 segment, the stream has incised into the broad valley floor, while in the upper U1 segment ’the stream meanders across the valley bottom. Above the U1 segment there is a short, high gradient headwater segment (H2) where the stream originates on the steep valley walls and cascades to the valley bottom,

The South Fork is steeper than the North Fork and does not exhibit glacial influence in valley formation. The channel is confined between steep sideslopes throughout its length. Low gradient, depositional segments (V4) alternate with moderate and steep gradient (V1 and V2) zones of sediment transport. The stream originates in a high gradient headwater segment (H2).

Watershed Conditions

Vegetation

Dominant Species and Timber Harvest Intensity. The Vegetation Overlay displays the location of the individual stands, with numbers that correspond to information about each stand in the Vegetation database. A complete listing from the Vegetation database is contained in Appendix D.

The majority of the watershed (87%) is forested. The lower portion, within the LT. Murray Wildlife Recreation Area, is managed primarily for elk habitat. Vegetation is manipulated to provide forage and cover for these big game animals. Forest lands within this area are classified as "forest with grazing" in the Vegetation database. Dominant tree species include Douglas-fir and ponderosa pine *(Pinus ponderosa)* in the lower watershed. Douglas-fir and grand fir *(Abies grandis)* are the dominant tree species in the upper watershed, which is managed primarily for timber production.

As shown in Table 8, 13% of the watershed is non-forested. Non-forest lands include 999 acres in rural residential and agricultural uses and 3,764 acres of scrubland (forage) in the lower elevations. Other vegetation types in the watershed include stream corridors and brush patches dominated by deciduous tree and shrub species, rock outcrops, lakes, an interstate highway right-of-way, and gravel pits.

Timber harvest prescriptions include clearcut as well as shelterwood (partial cut) harvests. Table 9 displays the acreage of forested lands in the watershed according to vegetation condition, along with an estimale of stand age, height and canopy closure.

As shown in Table 9, approximately 19% of the watershed has been clearcut in the past 35 years and 17% has been shelterwood harvested. Clearcut stands are less than 35 years old and include the "regeneration", "seedling", and "sapling" categories. Two categories of shelterwood harvests are described based on canopy closure. Uncut stands include mature timber, naturally small diameter stands ("pole" category), and noncommercial forest areas (poor growing sites unsuitable for timber harvest).

Table 8. Vegetation Types within the Taneum Creek Watershed

Vegetation Type	Acres	%of Watershed
Forest:		
Forest with grazing	12,994	25%
Forest with no grazing	32,976	62%
	45,970	87%
Nonforest:		
Residential	60	
Cultivated cropland	939	2%
Noncultivated pasture and forage	3,764	7%
	4,763	9%
Other:		
Stream corridor	473	1%
Brush	315	
Rock outcrops	1,417	3%
Lakes	11	
Highway right-of-way	80	
Gravel pits	28	
	2,324	4%

Table 9. Vegetation Conditions of Forested Lands within Taneum Creek Watershed

Condition	Age	Height (ft)	Canopy Closure	Acres	% of Watershed
Managed Stands:					
Regeneration[1]	0 to 10	0 to 4.5	any	8,287	16%
Seedling	10 to 20	4.6 to 15	any	460	1%
Sapling	20 to 35	15.1 to 30	>50%	1,035	2%
Shelterwood[2]	:> 50	> 61	> 60%	7,587	14%
Shelterwood	> 50	> 61	> 60%	.1,677	3%
Total Managed Stands:				19,046	36%
Uncut Stands:					
Pole	>35	30 to 60	any	1,492	3%
Mature3	:, 50	> 61	> 70%	24,350	46%
Noncommercial	any	> 30	< 70%	1,082	2%
Total Uncut Stands				26,924	51%
Nonforest				7,087	13%

Includes WDW "woodland" category, which may encompass naturally sparse stands of 20% to 45% canopy closure.

Includes WDW "open conifer" category, which may encompass naturally sparse stands of 45% to 70% canopy closure.

Includes WDW "closed conifer" category.

It should be noted that two systems of vegetation classification were applied in the Taneum Creek watershed: WDW habitat cover types in the lower watershed and USFS vegetation condition classes in the upper watershed. The two systems have been combined !,n Table 9 to portray vegetation conditions in the entire watershed.

Through aerial photo interpretation, it was determined that the WDW "woodland" habitat types are generally recent clearcuts or seed tree harvests equivalent to USFS "regeneration" categories; "open conifer" stands are shelterwood harvests equivalent to USFS "shelterwood" categories; and "closed conifer" stands are equivalent to USFS "mature" stands. However, the WDW categories of "woodland" and "open conifer" may include naturally sparse stands, rather than managed stands. Therefore, Table 9 may overestimate the acreage of managed stands in the watershed. Another source of error in Table 9 is that the WDW inventory is only current to 1986, and recent timber harvest activities are not represented. These two sources of error should be kept in mind when viewing Table 9.

Riparian Condition. Deciduous species including quaking aspen *(PopuIus tremuloides)*, black cottonwood *(Populus trichocarpa)*, red alder *(Alnus rubra)* and willow *(Salir* spp.) are the dominant riparian vegetation within the lower, wide alluviated valley bottom. As the valley narrows, ponderosa pine mingles with the deciduous species. In the tightly confined canyon segments farther upstream, riparian vegetation is less distinct from the upland vegetation, and grand fir, Douglas-fir and western red cedar *(Thuja plicata)* become the dominant riparian tree species.

Table 10 displays the condition of riparian vegetation along the mainstem and both forks of Taneum Creek. The vast majority of the riparian vegetation is comprised of mature conifers. Openings in the canopy occur in the agricultural areas along the lower mainstem. Other impacts on the riparian vegetation along the mainstem include numerous dispersed camp sites as well as selective logging in the 1930's to 1940's. Recent timber harvest has affected 19% of the North Fork, while a small natural meadow provides the only significant opening in the canopy along the South Fork.

Disturbance History

Roads. Roads have been constructed within the basin primarily to accommodate timber harvest activities. An interstate highway crosses the watershed near the mouth. The Road Overlay displays the location and class of roads in the basin.

There are 3.4 miles of interstate highway, 56.6 miles of main haul roads; 108.0 miles of arterial, gravel-surfaced roads; and 116.0 miles of unimproved or temporary spur roads. Total length of roads is 284 miles, resulting in a road density of 3.2 miles per square mile.

The majority of the roads are arterial, gravel-surfaced roads and temporary spur roads. The highest concentration of roads is in the lower watershed within the L.T. Murray Wildlife Recreation Area. Many of these roads are currently closed to public motor vehicle access.

Table 10. Condition of Riparian Vegetation Along the Mainstem, North Fork, and South Fork of Taneum Creek

Condition	Length of Riparian Vegetation (ft)	% of Riparian Area
Mainstem:		
Agriculture	500	1%
Forage (nonforest)	1,750	2%
Deciduous	21,500	31%
Mature conifer	45,000	66%
	68,750	
North Fork:		
Regeneration (0 to 10 years)	11,250	17%
Shelterwood	1,500	2%
Mature conifer	52,600	81%
	65,350	
South Fork:		
Natural meadow	750	2%
Pole	4,000	9%
Mature conifer	41,000	89%
	45,750	

Mass Wasting. No areas of active mass wasting were identified during aerial photo review and field investigations on April 23 and 27, 1991. This watershed inventory project did not include a comprehensive landslide inventory, however, and these observations should not be interpreted as an inventory of all past and present instabilities in the watershed. Landslide initiation areas and tracks are being inventoried by Ginette Smith of the University of Washington as part of another TFW project.

Fires, Floods, and Other Disturbances. Railroad tracks were laid in the mainstem valley bottom and extended up to South Fork meadows in the late 1930's to early 1940%. Selective removal of large trees occurred during this time, but it wasn't until the 1950's to 1960's that logging began in earnest. There have not been any large fires in recent history in the watershed. (Foss pers. comm.)

Taneum Creek experienced a relatively high magnitude flood in the winter of]990/1991. A ford was washed out and fish habitat improvement projects are planned for the summer of 1991. (Staley pers. comm.)

Land and Water Use

Dams, Mining, Etc.. There is a low dam near the mouth of Taneum Creek which is part of a water diversion project. A fish ladder provides for passage of anadromous fish above the dam. Two diversion ditches cross the lower part of the watershed.

Taneum Creek watershed is a popular public recreation area. The watershed is used for hunting, camping, and hiking. There are numerous campgrounds and dispersed camping areas within the riparian area in the lower valley, and trails along both the North and South Forks in the upper valley.

Twelve gravel pits arc located within the watershed. These are identified on the Vegetation Overlays and database.

Miscellaneous Features. Miscellaneous features in the watershed include non-forested brush lands, numerous rock outcrops, and five lakes. The location and size of these features is included on the Vegetation Overlays and database.

PART 2. TACOMA CREEK

The Tacoma Creek watershed is located approximately 50 miles north of Spokane on the eastern slope of the Sclkirk Mountains. The 44.6-square mile watershed lies within Sections 1 and 2 of Township 33 North, Range 43 East; Sections 1 through 17; 21, 22, and 24 of Township 34 North, Range 42 East; Sections 3 through 10, 15 through 22, 25 through 29, and 33 through 36 of Township 34 N, Range 43 E; Sections 13 through 15, 21 through 28, and 32 through 36 of Township 35 North, Range 42 East; and Sections 30 through 33 of Township 35 North, Range 43 East.

Tacoma Creek is a tributary to the Pend Oreille River. The portion of the watershed included in this study is that area above the junction with the South Fork Tacoma Creek, approximately 1.5 miles upstream of the mouth.

Methods

Watershed Characteristics

Climate

Elevation. The watershed boundary was delineated on the Jared, Tacoma Peak, CalispelI Peak, Lake Gillette, and Timber Mountain USGS $7^{1/2}$ minute topographic maps. Basin and mean elevation were calculated in the same manner as described in Part 1.

Precipitation. Precipitation information was obtained from USGS Climatedata disks. The Climatedata disks were searched to locate weather stations that are within 40 miles of Tacoma Creek and within the elevational range of the watershed.

Two stations were used to represent precipitation within the watershed: Newport at 2,140 feet in elevation and Mt. Spokane Summit at 5,890 feet. A summary of average monthly precipitation and snowfall for each of these stations is included in Appendix A. The data for the two stations was averaged to obtain an estimate of the monthly and annual precipitation for the Tacoma Creek watershed.

The 24year, 24-hour precipitation event for the watershed was determined by consulting the NOAA Precipitation Frequency Atlas (1970). The average of the isopluvials crossing the basin was taken as the 2-year, 24-hour precipitation for the basin.

Air **Temperature.** Air temperature information was obtained from the USGS Climatedata disks. Because daily temperature values were not available, average monthly values were used. Average monthly maximum and minimum temperatures for Newport and Mr. Spokane Summit were averaged to provide an estimate of temperatures in the Tacoma Creek watershed. A summary of the temperature information for the two stations is included in Appendix A.

Water Temperature. Water temperature information was not available for Tacoma Creek.

Geology. The Geologic Map of the Newport Number 2 Quadrangle (Miller 1978 - original scale 1:62,500) and the Geologic Map of the Chewelah Mountain Quadrangle (Clark and Miller 1968) were reproduced at a scale of 1:24,000 to construct the Geology Overlay for the majority of the watershed. Geologic information has not been published for the northern portion of the watershed on the Lake Gillette and Timber Mountain quadrangles (12% of the watershed area). Geologic mapping units were estimated using the Geologic Map of Washington (Huntting et al. 1961, original scale 1:500,000) for this area.

Mapping unit boundaries displayed on the Geology Overlay should be viewed with the original scale of these maps in mind. The Geology Overlay is designed to provide a general characterization of the geologic makeup of the watershed rather than a detailed investigation.

Soils. The Soils Overlay was constructed using the State Soil Survey Township Soil Maps (original scale 1:24,000). Information from the State Soil Survey Report for the Northeast area (WDNR 1975) was then incorporated into a Dbase database. The database includes acreage of each mapping unit, soil name, natural and disturbed stability ratings, road-related erosion hazard, timber harvest-related erosion hazard, and site index. These parameters are explained in the database description included in Appendix C.

Hydrology

Drainage Network and Basin Dimensions. Stream orders were completed for the watershed using the standard method developed by Strahler (1964) and previously explained in Part 1.

Watershed area was measured with a Plank planimeter. Tacoma Creek is a fourth-order stream; it was divided into two third-order subwatersheds. Basin length was measured from the mouth to the drainage divide following the main channel. Basin width was measured at the midpoint of the channel, perpendicular to the direction of flow. Relief ratio was calculated as the basin relief divided by the length of the basin (Dunne and Leopold 1978).

Flow. Tacoma Creek is ungaged; therefore streamflow was estimated using a nearby gaged stream. Calispell Creek is approximately 10 miles south of Tacoma Creek. Climate, geology, topography, and basin area of Calispell Creek is quite similar to Tacoma Creek. Streamflow was measured from 1950 to 1974 in the 68 square-mile CalispeI1 Creek basin. Appendix A contains a summary of the Calispell Creek gaging data.

According to Orsborn (1990), "any group of similar basins of the same size and which receive the same amount of annual precipitation, will have about the same amount of average annual flow." Therefore, average annual flow for Tacoma Creek was estimated by multiplying the basin area by the average annual runoff per square mile for Calispell Creek. Monthly flows for Tacoma Creek were then estimated by calculating the ratio of monthly to average annual flows for Calispell Creek and multiplying by the estimated average annual flow for Tacoma Creek. Maximum, mean, and minimum monthly flow estimates were generated by multiplying the calculated ratios by the estimated average annual flow for Tacoma Creek. One standard deviation above and below the mean was also calculated to display the flow variability. This method of developing ratios of monthly flows to estimate flow in an ungaged watershed was tested by Amerman and Orsborn (1987).

In order to develop a flow duration curve, daily flows for Calispell Creek were ordered from lowest to highest. The low flow with a 0.05 probability (20-year recurrence interval) and high flow with a 0.5 probability (2-year recurrence interval) were then determined. The ratio of these characteristic flows to the average annual flow of Calispell

Creek was then calculated. The 1-day, 20-year average low flow (Q1L20), and 1-day, 2-year average flood flow (Q1F2) were then estimated for Tacoma Creek by multiplying the average annual flow for Tacoma Creek by the Calispell Creek ratios.

A flow duration curve was developed by assuming that Q1F2 is exceeded 0% of the time, QAA is exceeded 32% of the time, and Q1L20 is exceeded 100% of the time.

Existing Studies. The Newport Ranger District of the Colville National Forest and the Upper Columbia United Tribes were contacted to determine whether any instream flow or other pertinent studies have been conducted on Tacoma Creek.

Geomorphology

Slope Classes. Landslope within the watershed was determined from the slope phases listed for each soil mapping unit in the State Soil Survey Report for the Northeast Area. The soil survey information was used because manual determination of slope classes from topographic maps (as described in Part 1, for Taneum Creek) is an extremely time consuming procedure. As a check on the accuracy of the slope phase information in the Soil Survey, the Timber Mountain quadrangle was also stratified into slope classes according to the methods described in Part 1. The two methods yielded similar results in portraying **the** relative acreage in each slope class.

Channel Profile. The methodology for constructing the channel profile is explained in Part 1.

Valley Segments. Valley segments were identified using the methodology developed by Cupp (1989) and previously described in Part 1.

Watershed Conditions

Vegetation

Dominant Species and Timber Harvest Intensity. The Colville National Forest and Plum Creek Timber company were contacted to obtain timber stand species composition, age, and stand density information.

The Newport Ranger District of the Colville National Forest provided 4 inch = 1 mile scale maps from timber stand inventories which covered most of the National Forest lands within the watershed. The stand exams included tree species, age, and harvest prescription, where applicable. Trees per acre was not available.

Some of the National Forest lands did not have a completed stand exam, and some of the stand exams had been done by aerial photo interpretation. Where information was lacking, interpretation of 1986 aerial photos was used to provide an estimate of stand age and dominant species. In order to distinguish stands for which information was photo-interpreted from stands for which more exact surveys had been completed, approximate ages were entered under the "Year of Origin" field for the photo-interpreted stands. Appendix D contains a complete explanation covering the fields in the vegetation database.

Plum Creek Timber Company supplied timber type maps at a scale of 5.28 inches = 5,280 feet. The timber type maps included dominant tree species, size class, and stocking class, with an estimate of tree age supplied by a Plum Creek forester.

Vegetation information for residential/agricultural land in the valley bottom and small tracts of timber land in private ownership near the mouth of the watershed was also interpreted from 1986 aerial photos. Stand age and dominant species were determined by comparing these stands to adjacent stands for which information had been supplied by the landowner. A comment to this effect is included in the database (Appendix D).

The final Vegetation Overlays consist of a series of numbered cells which are keyed to a Dbase database that contains information on cell acreage, dominant and subdominant species, year of origin, and harvest prescription. The acreage of the stands reported in the database is the gross map acres. '*Ribbon acres" of roads within the stands have not been subtracted from the stand acreage.

Also included in the Vegetation database is locational information, including water resource inventory area (WRIA), subwatershed, legal description, ownership, and identification number assigned by the landowner. The comments section identifies stands for which vegetation information was interpreted from aerial photos.

Riparian Condition. Riparian stand species and ages were determined from the mouth of Tacoma Creek, upstream to the headwaters. The length of stream corridor occupied by each stand was measured on the Vegetation Overlay and recorded in the riparian database. Tree species and age were obtained from the timber stand inventories supplied by the landowners and verified using the 1986 aerial photos.

Appendix D contain a complete description of the riparian database for Tacoma (.'reek.

Disturbance History

Roads. The location of roads in the watershed was determined using 1:12,000 scale 1986 aerial photos and maps supplied by the Newport Ranger District and Plum Creek Timber Company. Roads were divided into three classes: main paved or gravel-surfaced, arterial gravel surfaced; and temporary spurs. The length of roads in each class was measured and road density was calculated as the length of road divided by the watershed area.

Mass Wasting. Landslides were inventoried using 1986 aerial photos. The May 7, 1991 field review also provided the opportunity for further verification of mass wasting activity.

Fires, Floods, and Other Disturbances. Local land managers were contacted to obtain information on past disturbances, including fire and floods.

Land and Water Use

Dams, Mining, Etc.. Field investigation and aerial photo review were used to check for past or active dams and mining activities affecting the basin. The location of gravel pits was determined from aerial photos.

Miscellaneous Features. The location of lakes, wetlands, powerlines, and other miscellaneous features was included in the timber stand inventories supplied by individual landowners. This information was further verified through examination of 1986 1:12,000 scale aerial photos. These features are mapped on the Vegetation Overlay and included in the Vegetation database (Appendix D).

Results

Watershed Characteristics

Climate

Elevation. Mean elevation of the basin is 3,600 feet. Elevation ranges from 2,040 feet at the junction with South Fork Tacoma Creek to 6,855 feet on Calispell Peak. Net relief is 4,815 feet.

Precipitation. Monthly precipitation and depth of snowfall is presented in Table 11 and Figure 6. Average annual precipitation for the watershed is 37 inches and average annual depth of snowfall is 113 inches. The snowfall depth does not reflect actual accumulation of the snowpack on the ground but, rather, the sum of individual snowfall events.

Air Temperature. Average maximum and minimum monthly temperatures are presented in Table 11 and Figure 7. The average annual maximum temperature is 51°F and the average annual minimum temperature is 31 °F

Water Temperature. No water temperature data was available for Tacoma Creek.

Geology. Table 12 displays the geologic makeup of the watershed. Phillips Lake Granodiorite and associated rocks underlie 52% of the basin, including the upper slopes and headwater areas. This igneous complex dating to the Cretaceous age contains the oldest rocks in the watershed. More recent glacial, alluvial and talus debris covers the lower slopes and valley bottoms. The Tacoma Creek drainage contains especially thick deposits of glacial drift (Miller 1974).

Table 11. Tacoma Creek Watershed Climatic Data Summary

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Annual
Total Precipitation (inches)	4.6	3.6	3.6	2.6	2.4	2.3	1.1	1.3	2.1	3.0	4.8	5.0	37.3
Snowfall Depth	30.1	15.8	15.1	5.6	2.5	0.3	0.1	0.0	0.9	4.3	12.4	24.9	113.2
Minimum Temperature (degrees F)	28	34	39	49	59	63	77	75	65	51	37	30	5I
M/n/mum Temperature	16	20	22	28	36	42	48	46	40	32	25	19	31

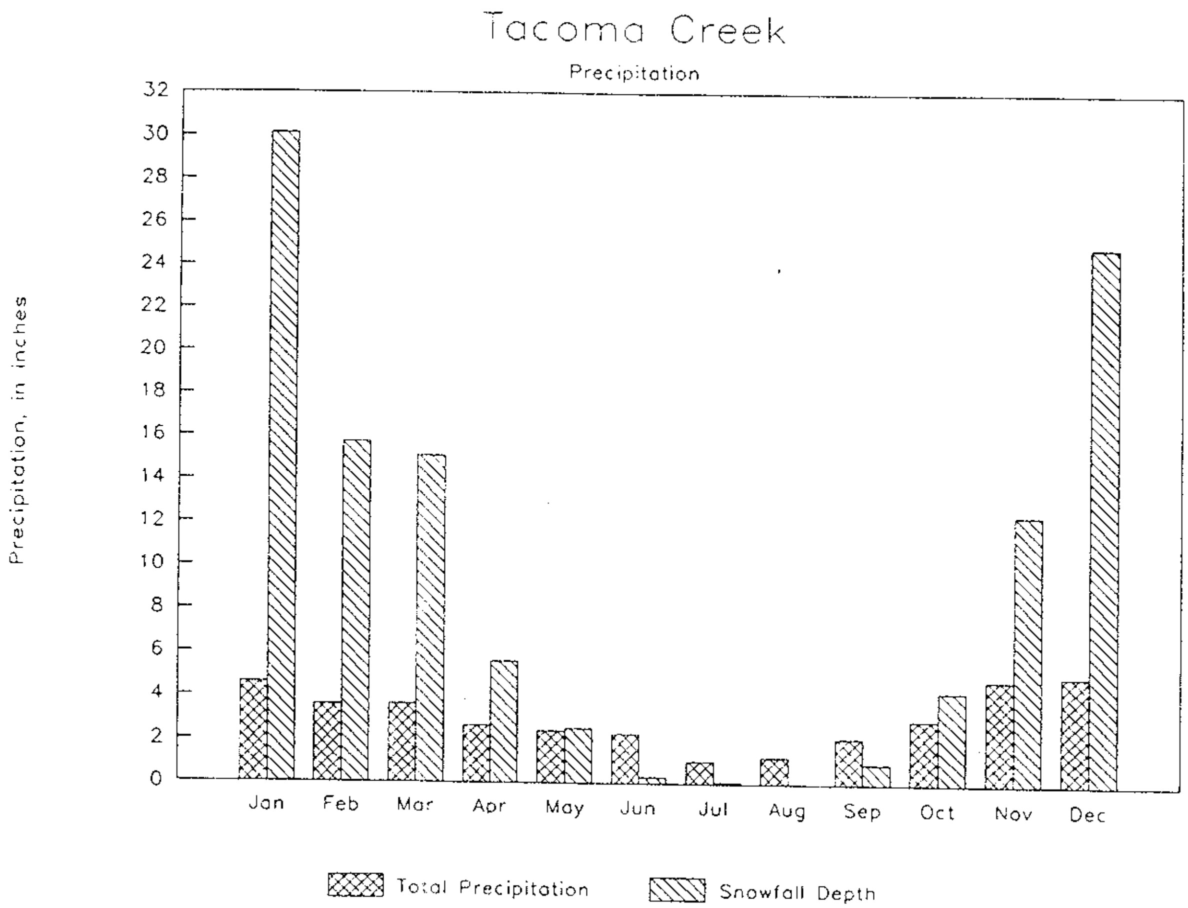

Figure 6. Estimated Average Monthly Precipitation for the Tacoma Creek Watershed

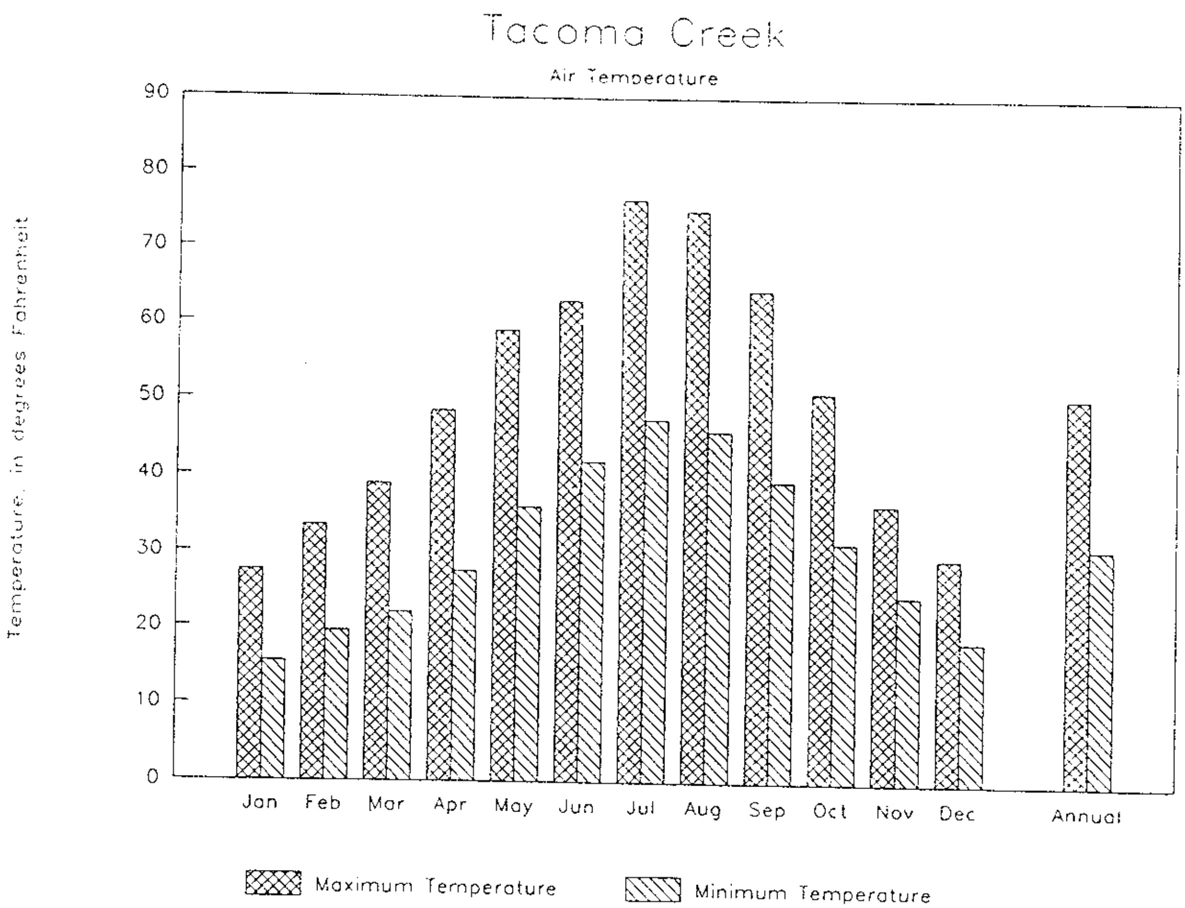

Figure 7. Estimated Monthly Air Temperatures for the Tacoma Creek Watershed

Table 12. Geologic Mapping Units within the Tacoma Creek Watershed

Unit/ Symbol	Description	General Category	Acres	%of Watershed
Qg, Qag	Glacial, alluvial and talus deposits	Unconsolidated deposits	13,218	46
Tt	Tiger formation	Sedimentary rock	273	1
Tc	Cataclastic rock	Volcanic rock	1.63	1
Mzg, Tkpa	Phillips Lake granodiorite	Volcanic rock	14,876	52

The Tiger formation outcrop of conglomerate underlies the low hills in the eastern portion of the watershed. This formation contains plant fossils and abundant carbonaceous material. The Newport Fault Zone is the major structural feature in the watershed. The fault zone strikes north through the eastern portion of the watershed. Cataclastic rock and mylkonite occur within the fault zone.

Soils. The Soils Overlay and database display the location and properties of the soils within the watershed. In an undisturbed state, nearly all soils within the watershed are rated as stable (Table 13). After disturbance by the construction of roads or landings, and/or by timber harvesting, the soils on 28% of the watershed are rated as unstable, and 4% is rated as very unstable.

The hazard for accelerated erosion of cut slopes, fill slopes, or sidecast material is rated as slight on 5,504 acres (19%); moderate on 14,075 acres (49%); and severe on 8,536 acres (30%). Areas unsuitable for road construction amounted to 415 acres (2%). The timber harvest-related erosion potential is rated as low on 4,840 acres (17%), medium on 15,786 acres (55%); and high on 7,781 acres (28%). Areas unsuitable for timber harvest amount to 33 acres. These ratings have been developed by the WDNR (1974) for the Northeast Area. They are explained in more detail in the soils database description, Appendix C.

Site index classes for the Tacoma Creek watershed are displayed in Table 14. Site index is a designation of the quality of a forest site based on the height of the tallest trees in a stand at the age of 50 years. The site index for the majority of the watershed applies to Douglas-fir stands and ranges from 81 to 120, none with an average of 101.

Hydrology

Drainage Network and Basin Dimensions. Tacoma Creek is a fourth-order stream with a watershed area of 28,530 acres. General orientation of the basin is southeast. One overlay displays the watershed boundary and stream orders. The Tacoma Creek watershed contains 43.1 miles of first-order streams, 20.0 miles of second-order streams, 5.8 miles of third-order stream, and 9.9 miles of fourth-order stream. Drainage density for the 44.6 square-mile watershed is 1.8 miles per square mile.

Basin width is 22,500 feet and basin length is 65,000 feet. The relief ratio is 0.06.

Flow. As described in the Methods section, streamfiow data for this ungaged basin was estimated using gaging data from nearby Calispell Creek. A summary of streamflow data for Calispell Creek is provided in Appendix A.

Monthly flow data computed for Taneum Creek is displayed in Table 15 and Figure 8. Highest flows occur during April and May in response to snowmelt runoff. These months also exhibit the highest flow variability. Lowest flows occur from August through October.

Table 13. Soil Stability Characteristics
within the Tacoma Creek Watershed

Condition	Natural Stability		Disturbed Stability	
Stable	26,942	(94)	18,944	(66)
Unstable	1,173	(4)	7,998	(28)
Very Unstable	0		1,I73	(4)
Not rated[1]	415	(2)		

Includes rock outcrops, lakes, and wetlands.

Note: Expressed in acres and percent of watershed area. Ratings are from the State Soil Survey Report for the Northeast Area (WA DNR 1975).

Table 14. Site Index for Tacoma Creek Watershed

Index Species	Site Index	Acres	% of Watershed
Douglas-fir	80 to 90	5,495	19
	100 to 119	17,360	61
	120	2,275	8
Ponderosa pine	80 to 99	504	2
	100 to 119	2,131	7
	120+	158	1
Quaking aspen[1]	50	46	
Not rated		559	2

80-year site curve

Table 15, Estimated Average Monthly Flow in Tacoma Creek

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Annual
D Max	70	237	234	297	546	479	636	432	165	82	23	30	636
+1 s.d,	14	22	36	34	63	82	224	193	65	24	13	i2	57
D Avg	11	15	21	22	34	51	154	I45	49	19	10	9	45
-1 s,d.	8	8	6	10	6	20	83	96	33	13	7	7	32
D Min	2	3	2	2	5	7	15	30	7	3	2	2	2

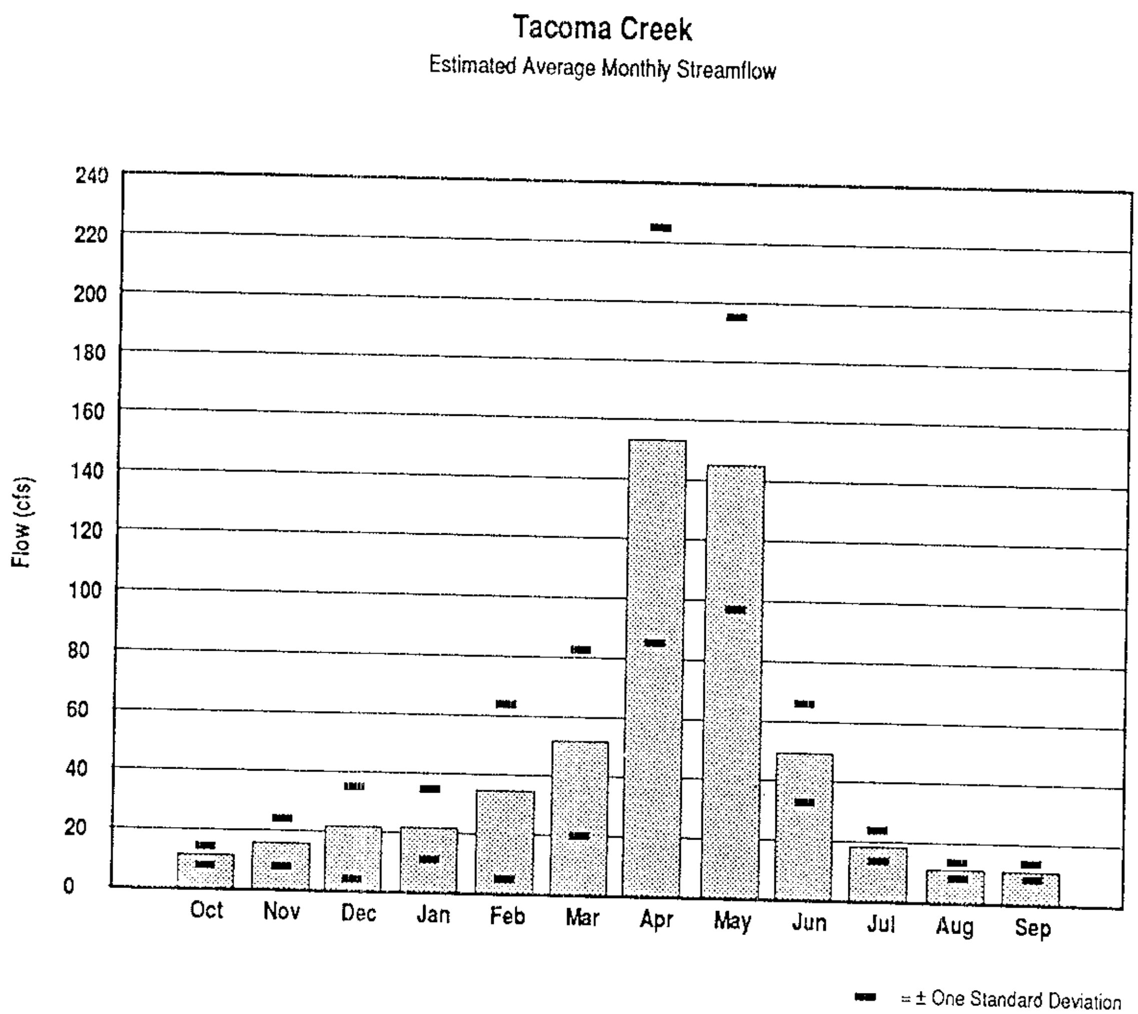

Figure 8. Estimated Average Monthly Streamflow in Tacoma Creek

Average annual flow is estimated at 45 cfs. This translates to an average annual runoff of 1.0 cfs per square mile. The 2-year flood flow was estimated to be 496 cfs. Figure 9 displays the flow duration curve developed for Tacoma Creek.

Existing Studies. A stream survey was conducted by a Northwest Indian Fisheries Commission crew with cooperation from the Upper Columbia United Tribes during the summer of 1989. The crew collected information on habitat unit distribution, channel substrate, habitat modifiers, and riparian vegetation according to a procedure described in the Timber/Fish/Wildlife Stream Ambient Monitoring Field Manual (Ralph 1990).

The Newport Ranger District of the Colville National Forest plans to construct 10 log "K" structures in Tacoma Creek during the summer of 1991. The purpose of this project is to improve resting and spawning areas for native and established fish populations.

Geomorphology

Slope Classes. Table 16 displays acreage of land in the slope classes, as determined from the slope phases in the State Soil Survey Report. The majority of the watershed is comprised of gentle slopes of less than 30%. Approximately one-third of the watershed is moderately steep, with slopes of 30% to 65%. A small portion of the basin contains steep slopes of 65% to 90%.

Channel Profile. The channel profile is displayed in Figure 10, while the data used to develop the profile are contained in Appendix B. A typical pattern of increasing slope from mouth to headwaters is exhibited by the channel.

Valley Segments. The distribution of valley segment types is shown on the Valley Segment Overlay. Table 17 and figure 11 describe the extent and slope of each valley segment type on the mainstem of Tacoma Creek. For a complete description of valley segment characteristics see Cupp (1989).

The valley segments found in the Tacoma Creek watershed indicate that valley formation has been influenced primarily by fluvial processes. The stream meanders through a wide, flat mainstem valley (F3) from the mouth to RM 1.2. Upstream of this segment the valley abruptly narrows and the channel is confined by moderately steep slopes. The channel gradient increases to 4% in this V1 segment.

Above the V1 segment the valley bottom widens and the channel gradient decreases to 1% to 2%. A zone of net deposition occurs between RM 2.0 and RM 10.1. The valley sideslopes fluctuate between gentle and steep, but valley bottom width remains slightly greater than twice the active channel width. The channel pattern is sinuous, with braids and side channels common. Thus, valley segment types alternate with the change in valley sideslope gradient from less than 30% (M2) to greater than 30% (V4).

Above RM 10.1 is a zone of net sediment transport. The moderate gradient channel is tightly confined between steep sideslopes in a V1 segment between RM 10.1 and 11.5.

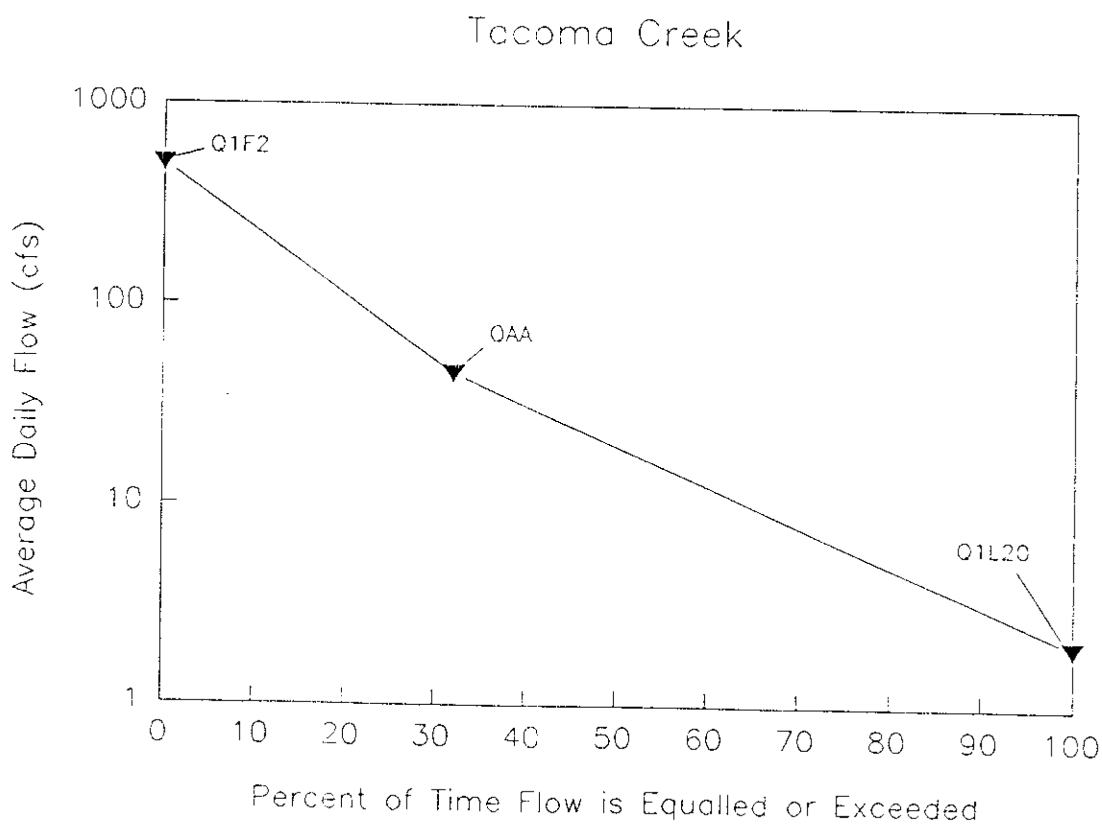

Figure 9. Estimated Flow Duration Curve for Tacoma Creek

Table 16. Slope Classes within the Tacoma Creek Watershed

Slope Class	Acres	Percent
0 to 5	988	4
5 to 30	16,950	59
30 to 65	10,485	37
65 to 90	107	
>90	0	

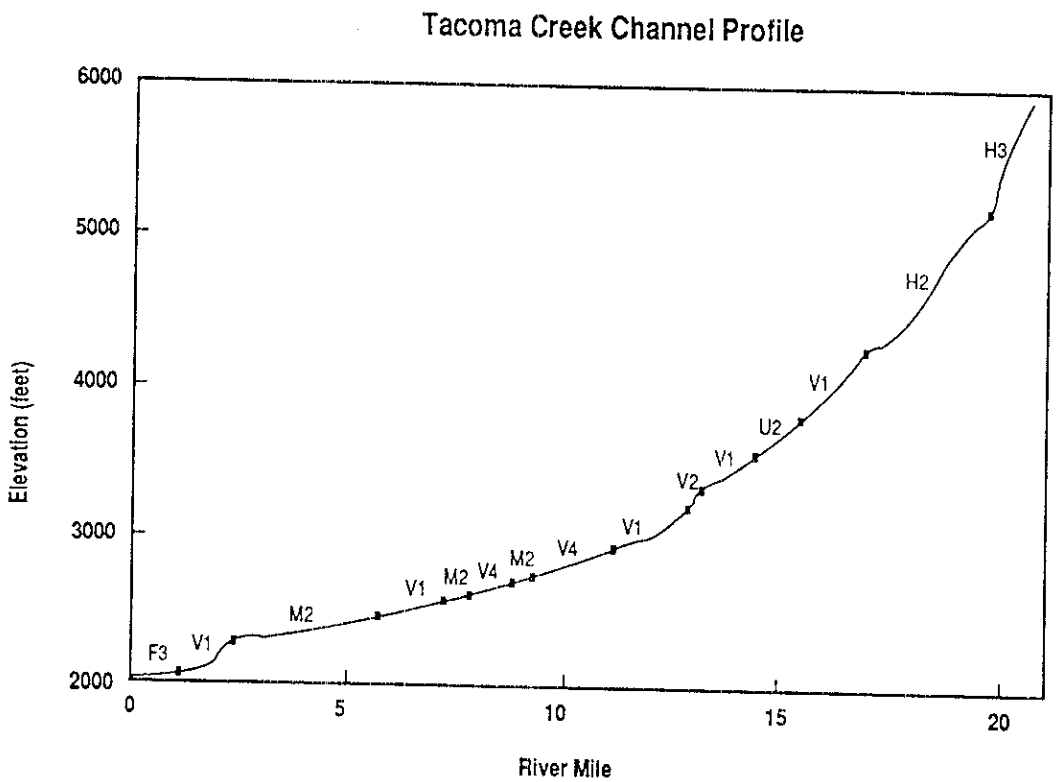

Figure 10. Tacoma Creek Channel Profile and Valley Segment Types

Table 17. Valley Segments on the Mainstem of Tacoma Creek

Segment[1]	Extent (River Mile)	Channel Slope
F3	0 to 1.2	1%
V1	1.2 to 2.0	4%
M2	2.0 to 6.2	1%
V1	6.2 to 7.0	2%
M2	7.0 to 7.4	2%
V4	7.4 to 8.1	1%
M2	8.1 to 8.5	1%
V4	8.5 to 10.1	2%
Vl	10.1 to 11.5	3%
V2	11.5 to 11.8	8%
V1	11.8 to 14.3	4%
U3	14.3 to 15.1	6%
V1	15.1 to 15.9	4%
}t2	1.5.9 to 17.5	8%
I-t3	1'7.5 to 18.4	14%

F3 Wide mainstem valley
V1 V-shaped, moderate gradient
V2 V-shapes, steep gradient
V4 alluviated mountain valley
M2 Alluviated, moderate slope bound
U3 incised, U-.shaped valley, high gradient
H2 High gradient headwater
H3 Very high gradient headwater

The V1 segment type dominates the valley up to the headwater reaches. It is interrupted by a short, high gradient V2 segment between RM 11.5 to 11.8, where the channel gradient increases to 8%. A somewhat unusual U3 segment also occurs from RM 14.3 to RM 15.1. The channel has incised into a U-shaped valley, a relict of past glaciation. The channel gradient is quite steep as it cuts through what is likely a morainal deposit. Above this segment, the channel is deeply incised between steep valley walls, returning to the overall V1 pattern of steep sideslopes and moderate gradient valley bottom.

Valley bottom gradient gradually increases towards the headwaters. Above RM 15.9 the channel becomes much smaller and gradient increases from 8% through the high gradient headwater segment (H2) to 14% in the very high gradient headwater segment (H3).

Watershed Conditions

Vegetation

Dominant Species and Timber Harvest Intensity. The Vegetation Overlay displays the location of individual cells, with numbers that correspond to information about each cell in the Vegetation database. A complete listing from the Vegetation database is included in Appendix D.

As shown in Table 18, the watershed consists primarily of forested lands. Douglas-fir, western larch *(Larix occidentalis),* lodgepole pine *(Pinus contorta),* and western hemlock are the dominant tree species in a diverse forest that also contains western red cedar, ponderosa pine, white pine *(Pinus monticola),* grand fir, subalpine fir *(Abies lasiocarpa),* and Engelmann spruce *(Picea engelmannii). The* watershed contains such a diversity of tree species that vegetation is best described as "mixed conifer", rather than listing one or two dominant tree species.

Table 19 displays the acreage of forested lands according to stand age. The most intensive period of timber harvest has been in the past decade. Regeneration harvest (clearcut) is the primary silvicultural treatment; seed tree harvests are implemented on about 10% of the harvest units. A small portion of the watershed (< 1%) has been partial cut or precommercial thinned.

Much of the watershed was affected by forest fires during the 1920’s and 1930’s. The result is a dense, mixed forest of 50 to 60 years in age, with pockets of mature and old growth forest in the valley bottoms and draws.

Riparian Condition. Hardwood riparian tree species include river birch *(Betula occidentalis),* red alder, and willow which occur primarily in the lower valley. Cold air flow down the valley bottom allows subalpine fir to extend all the way down Tacoma Creek to the Pend Oreille River valley at 2,000 feet. Other coniferous tree species found within the riparian area include white pine, grand fir, western red cedar, and western hemlock.

Table 18. Vegetation Types within the Tacoma Creek Watershed

Vegetation Type	Acres	% of Watershed
Forest	27,937	98%
Nonforest:		
noncultivated pasture	98	--
wetlands	242	1%
lakes	20	--
rock outcrops	208	1%
powerline right-of-way	25	--

Table 19. Stand Age of Forested Lands in the Tacoma Creek Watershed

Stand Age as of 1990	Acres	% of Watershed
1 to 10 years	2,182	8%
11 to 20 years	1,157	4%
21 to 30 years	568	2%
31 to 40 years	260	1%
41 to 50 years	388	1%
51 to 60 years	4,267	15%
61 to 90 years	16,695	59%
> 90 years	2,422	8%
Nonforest	591	2%

As shown in Table 20, the majority of the mainstem Tacoma Creek riparian area has not been affected by timber harvest. Harvest has occurred within 4% of the riparian corridor, near the headwaters. Timber harvest has taken place adjacent to another 3% of the riparian area, where a buffer of mature timber has been left along the stream. The mixed hardwood buffer is along the lower valley, adjacent to clearings created for residential and agricultural uses.

Disturbance History

Roads. Roads have been constructed within the basin primarily to accommodate timber harvest activities. The Road Overlay displays the location and class of roads in the basin. There are 14.8 miles of main haul roads; 64.7 miles of arterial gravel-surfaced roads; and 66.0 miles of unimproved or temporary spur roads in the watershed. Road density of the entire watershed is 3.3 miles per square mile.

Mass Wasting. No active landslides were identified during review of 1986 aerial photos. Field review of the watershed was restricted to the lower portion due to the impassable condition of roads which had been recently plowed. Although no areas of mass wasting were observed, sheetwash erosion of the road prism occurs throughout the watershed. Numerous roadside ditches were filled with sediment, and rill erosion was occurring on road surfaces and fillslopes.

Fires, Floods, and Other Disturbances. Wildfires burned much of the watershed in the 1920's and 1930's. Today dense mixed stands containing lodgepole pine and western larch of about 55 years in age extend across the slopes, while sheltered fingers of mixed firs, cedar and hemlock extend along streamcourses jumped by the fires. Mountain pine beetle has invaded some of the lodgepole pine stands in the upper watershed (Wright pers. comm.). There is no history of flooding in the watershed.

Land and Water Use

Dams, Mining, Etc.. There are no dams or evidence of past mineral mining activities within the watershed. Other land uses include early homesteads and associated logging and land clearing. Many of the homesteads were turned over to the USFS after abandonment. The high meadows of Calispell Peak once supported a grazing allotment, but today there is only a minor amount of grazing in the lower watershed (Wright pers. comm.).

Miscellaneous Features. Miscellaneous features in the watershed include a powerline right-of-way, rock outcrops, several wetland, and two lakes. The locations of these features are shown on the Vegetation Overlay. Rural residential areas and small agricultural enterprises occupy 98 acres within the lower valley.

Table 20. Condition of Riparian Vegetation Along the Mainstem of Tacoma Creek

Vegetation Type	Age as of 1990	Length (ft)	% of Riparian Area
Managed Stands:			
Clearcut	1 to 10 years	3,750	**4%**
Mixed conifer buffer	> 60 years	3,000	3%
Mixed hardwood buffer	> 60 years	2,850	3%
Non-managed Stands:			
Mixed conifer	50 to 60 years	10,500	10%
	60 to 90 years	64,500	64%
	>90 years	3,000	3%
Mixed hardwood	> 60 years	12,500	12%

PART 3. COMPARATIVE SUMMARY AND CONCLUSIONS

Comparison of Watershed Characteristics

The Taneum Creek watershed lies mostly within the Cascades ecoregion, with a small portion of the lower watershed in the Columbia Basin ecoregion. Tacoma Creek watershed is approximately 200 miles northwest of Taneum Creek, in the Northern Rockies ecoregion (Omernik and Gallant 1986). A summary of the natural characteristics of the two study areas is provided in Table 21.

Despite the difference in geographic setting and ecoregion, the watersheds experience a similar climate, since both are on the eastern slope of a north-south trending mountain range. Taneum Creek has a slightly higher mean basin elevation, but Tacoma Creek has a greater basin relief and higher peak elevation.

Both watersheds are underlain by rock of volcanic origin, but the nature of the rock is quite different. The volcanic rock of Taneum Creek stems primarily from basalt flows, while Tacoma Creek is underlain by intrusive granodiorite. Tacoma Creek watershed also contains a higher proportion of unconsolidated alluvial, glacial, and talus deposits.

Soil stability characteristics are difficult to compare, since 11% of the Taneum Creek watershed is not covered by a completed soils survey. While the majority of both watersheds contain soils rated as stable in the undisturbed state, Taneum Creek appears to have a higher proportion of soils rated as unstable when disturbed by logging or road construction. The disturbed soil stability ratings correspond with the slope classes in both watersheds; the percentage of the watershed in gentle slopes (<30%) is nearly identical to the percentage of the watershed with soils rated as stable under disturbance.

Taneum Creek is a fifth-order stream draining a watershed nearly twice as large as the fourth-order Tacoma Creek. The difference in stream order is reflected in the valley segment types; Taneum Creek has a much longer wide, mainstem valley segment (F3) than Tacoma Creek. Drainage densities are the same, but Tacoma Creek was estimated to have a higher average annual runoff per square mile than Taneum Creek. Tacoma Creek also has a higher relief ratio than Taneum Creek.

Slopes in Taneum Creek watershed are steeper overall than in Tacoma Creek watershed, and this is reflected in both the soil stability ratings and the primary valley segments types. Above the lower, wide mainstem valley (F3), valley segments on Taneum Creek alternate between V-shaped valleys where alluvial deposition has created a flat valley bottom (V4), and tightly confined, V-shaped valleys where erosion and sediment transport predominate (V1). Valley segments on Tacoma Creek exhibit a similar pattern of alternating between sediment deposition and transport, but valley sideslopes are gently sloping for much of the lower part of the creek, and, therefore, alluviated moderate-slope bound segments (M2) are common.

Table 21. Comparison of Watershed Characteristics in Taneum and Tacoma Creek Watersheds

	Taneum Creek	Tacoma Creek
Climate		
Mean elevation	4,000 feet	3,600 feet
Basin relief	4,590 feet	4,815 feet
Avg. annual precipitation	36"	37"
Avg. annual max temp	55oF	51oF
Avg. annual rain temp	30oF	31oF
Geology		
Unconsolidated Deposits	23%	46%
Sedimentary rock	7%	1%
Volcanic/Intrusive rock	49%	53%
Metamorphic rock	20%	
Soils		
Natural stability	79% stable (11% not rated)	94% stable
Disturbed stability	38% stable 51% unstable	66% stable 32% unstable
Average site index	df=84	df=101
Hydrology		
Basin size	53,057 acres	28,530 acres
Stream order-mainstem	5	4
Drainage density	1.8mi/mi^2	1.8 mi/mi^2
2-year flood flow	508 cfs	496 cfs
Geomorphology		
Slope Classes:		
<30%	35%	63%
30% to 65%	64%	37%
> 65 %	1%	

Table 21. Continued

	Taneum Creek	Tacoma Creek
Primary Valley Segments:	F3:6.1 mi VI: 7.9 mi V4:13.9 mi	F3: 1.2mi M2:5.0 mi VI: 6.3 mi V4:2.3 mi

Growing conditions for trees are quite different in the two watersheds. Ninety-eight percent of the Tacoma Creek watershed is forested, and the site index for Douglas-fir is higher than in Taneum Creek. The Taneum Creek watershed includes agricultural and rangeland in the lower portion, in addition to over 2,499 acres (5% of the watershed) of rock outcrops and noncommercial forest lands (poor tree growing sites, primarily due to shallow, rocky soils). Total nonforest lands amount to 13% of the Taneum Creek watershed.

Overall, the Tacoma Creek watershed has a somewhat higher inherent stability than the Taneum Creek watershed. This conclusion is based primarily on the greater percentage of the watershed containing gentle to flat slopes, and greater proportion of the watershed under forest cover. However, the granodiorite underlying much of Tacoma Creek watershed can produce highly erodible soils, and considerable erosion along road cut and fillslopes was observed during the field investigation. While mass wasting did not appear to be a common occurrence in either watershed, sheetwash and rill erosion is a concern in both watersheds.

Comparison of Watershed Conditions

Dominant tree species in the Taneum Creek watershed are Douglas-fir, ponderosa pine, and grand fir, while Douglas-fir, western hemlock, western larch, and lodgepole pine predominate in Tacoma Creek watershed. As indicated by the average site index, Tacoma Creek provides better overall tree-growing conditions.

Timber production is a major land use in both watersheds, although the lower portion of Taneum Creek, within the L.T. Murray Wildlife Recreation Area, is managed primarily to provide habitat for elk. Taneum Creek watershed includes a higher percentage of land in rural residential and agricultural uses than Tacoma Creek. A summary of the management-affected conditions of the two watersheds is provided in Table 22.

Timber harvest has affected 36% of the Taneum Creek watershed and only 17% of the Tacoma Creek watershed. Harvest prescriptions are almost evenly divided between clearcuts and partial cuts in Taneum Creek, while clearcuts predominate in Tacoma Creek.

The majority of timber harvest activities have occurred in the past decade in both watersheds. Stands younger than 10 years in age comprise 16% of Taneum Creek watershed and 8% of Tacoma Creek watershed. Mature forests greater than 50 years of age cover 82% of Tacoma Creek watershed and 46% of Taneum Creek watershed. The majority of the riparian area is intact in both drainages.

Road density is 3.2 miles per square mile in the Taneum Creek watershed and 3.3 miles per square mile in Tacoma Creek. While the road densities are fairly similar, it should be kept in mind that Taneum Creek watershed is more than twice as large as Tacoma Creek watershed.

Table 22. Comparison of Watershed Conditions in Taneum and Tacoma Creek Watersheds

	Taneum Creek	Tacoma Creek
1. Vegetation		
Dominant tree species:	Douglas-fir, ponderosa pine, grand fir	Douglas-fir, western larch, lodgepole pine, western hemlock
Percent forested	87%	98%
Age distribution		
0 to 10 years	16%	8%
11 to 20 years	I%	4%
21 to 35 years	2%	3%
Partial cut (> 50 years)	17%	2%
Pole (> 35 years)	3%	0%
Mature (> 50 years)	46%	82%
Percent clearcut	**19%**	15%
Percent partial cut	17%	2%
Percent of riparian area clearcut	6%	4%
2. Road Density	3.2 mi/mi^2	3.3 mi/mi^2

Analysis of the management-affected conditions of the two watersheds leads to the conclusion that Taneum Creek watershed has been more highly impacted by timber harvest activities in Tacoma Creek watershed. However, the difference in the percentage of forested lands between the two study areas makes comparison difficult, since 13% of Taneum Creek watershed is non-forest. A future comparison of the South or North Fork Taneum Creek watershed to the Tacoma Creek watershed may be more appropriate and lead to a better understanding of the influence of inherent watershed characteristics on the impact of management activities.

Citations

PRINTED REFERENCES

Amerman, Karen S., and John F. Orsborn. 1987. An analysis of streamflows on the Olympic Peninsula in Washington state. Alderbrook Hydraulics Laboratory, Washington State University, Pullman, WA.

Center for Streamside Studies. 1.990. Timber/fish/wildlife stream ambient monitoring field manual; unpublished report. Center for Streamside Studies, Unviersity of Washington. Seattle, WA.

Clark, Lorin I)., and F. K. Miller. 1968. Geology of the Chewelah mountain quadrangle, Stevens County, Washington. U.S. Geological Survey and Washington State Department of Natural Resources Division of Geology and Earth Resource Map GM-5.

Cupp, C. Edward. 1989. Stream corridor classification for forested lands of Washington. Washington Forest Protection Association. Olympia, WA.

Dunne, Thomas, and Luna B. Leopold. 1978. Water in environmental planning. W.H. Freeman and Company. New York, NY.

Huntting, M. T., W. A. G. Bennett, E. Livingston, Jr., and W. S. Moen. 1961. Geologic map of Washington. State of Washington Department of Natural Resources. Olympia, WA.

Linsley, R. W., M. A. Kohler, and J. L. Paulhaus. 1975. Hydrology for engineers. McGraw-Hill, Inc. New 'York, NY.

Miller, Fred K. 1974. Preliminary geologic map of the Newport Number 2 quadrangle, Pend Oreille and Stevens Counties, Washington. U.S. Geological Survey and Washington State Department of Natural Resources Division of Geology and Earth Resources map GM-8.

NOAA. 1970. Atlas 2. Precipitation -. frequency atlas of the western United States. Volume IX - Washington. U.S. Government Printing Office. Washington, DC. Stock No. 003-017-00162-8.

Omernik, J. M., and A. L. Gallant. 1986. Ecoregions of the Pacific Northwest. U.S. Environmental Protection Agency Report. EPA/600/3-86/033.

Strahler, A.N. 1964. Quantitative geomorphology of drainage basins and channel networks; section 4-2 in Handbook of Applied Hydrology (ed. Ven te Chow), McGraw-Hill. New York, NY.

Tabor, R. W., R. B. Waitt Jr., V. A. Frizzell Jr., D. A. Swanson, and G. R. Byerly. 1982. Geologic map of the Wenatchee 1:100,000 quadrangle, central Washington. U.S. Geological Survey miscellaneous investigation series map 1-1311.

Walsh, T., J., M. A. Korosec, W. M. Phillips, L. Logan, and H. W. Schasse. Geologic map of Washington - southwest quadrant. Washington State Department of Natural Resources geologic map GM 34.

Washington Department of Natural Resources. 1975. State soil survey township soil maps and soil survey report for the Yakima River District of the Southeast Area. Olympia, WA.

Washington Department of Natural Resources. 1975. State soil survey township maps and soil survey report for the northeast area, Arcadia District. Olympia, WA.

PERSONAL COMMUNICATIONS

Bambrick, Dale. Fisheries biologist. Yakima Indian Tribe, Ellensburg, WA. March 26, 1991 - telephone conversation.

Berndt, Gary. Hydrologist. Washington Department of Natural Resources, Ellensburg, WA. May 29, 1991 - telephone conversation.

Foss, Tim. Forestor. Cle Elum Ranger District, U.S. Forest Service, CIe Elum, WA. April 23, 1991 - meeting.

McKinney, Charley. Fisheries biologist. Washington Department of Ecology, Yakima, WA. April 25, 1991 - telephone conversation.

Owens, Ron. GIS coordinator. Central Washington University, Ellensburg, WA. April 22, 1991 - telephone conversation.

Perala, Onni. Hydrologist. Bureau of Reclamation, Yakima, WA. May 22, 1991 - telephone conversation.

Smith, Ginette. Graduate student. University of Washington, Seattle, WA. April 22, 1991 - telephone conversation.

Staley, Kathryn. Fisheries biologist. Cle Elum Ranger District, U.S. Forest Service, Cle Elum, WA. April 23, 1991 - meeting.

Wright, Carl. Silviculturist. Newport Ranger District, U.S. Forest Service, Newport, WA.
May 7, 1991 - meeting.

Appendix A. Climate and Hydrology

Appendix A. Climate and Hydrology

Climatic information for the two study watersheds was obtained by area-weighting the climatic data for nearby weather stations. The area-weighting was accomplished by drawing lines on the topographic maps halfway between the contours represented by the elevation of each climatic station. Each station was assumed to represent the watershed area within these lines. A weighting factor was then assigned based on the percent of the watershed area represented by each station.

The equation for the climatic data in Taneum Creek watershed is: .30 X Ellensburg + .70 X Bumping Lake. The equation for Tacoma Creek watershed is: .50 X Newport + .50 X Mr. Spokane Summit.

Tables A-1 through A-4 display the summary of precipitation for the climatic stations. Snowfall depth is summarized in Tables A-5 through A-8, maximum air temperature in Tables A-9 through A-12, and minimum air temperature in Tables A-13 through A-16.

Streamflow was estimated using gaging data for nearby streams, as described in the Methods Section (main text). Tables A-17 through A-18 present monthly streamflow data for Manastash and Naneum Creeks, which was used to estimated flow in Taneum Creek. Table A-19 presents this information for Calispell Creek, which was used to estimate flow in Tacoma Creek.

Table A-1

ELLENSBURG

Id	2505	Latitude 46:58:00		Parameter	Rain
Elevation	i480	Longitude 120:33:00		Coverage	96.28%
Begin Date 1/1901		End Date 12/1986		Record Cnt	75

Summary of Precipitation, in inches

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
D Cnt	2262	2090	2263	2125	2231	2155	2261	2200	2157	2249	2159	2259	26411
D Avg	0.04	0.03	0.02	0.02	0.02	0.02	0.0I	0.01	0.02	0.02	0.04	0.05	0.02
M Cnt	73	74	73	71	72	72	73	7I	72	72	72	73	67
Max M	4.39	3.20	340	2.15	2.16	4.54	1.67	1,70	2.76	1.84	4.30	3.46	17.44
Maxyt	1970	1902	1971	1963	1915	1905	1908	1975	1911	1962	1921	1933	1937
MmM	0.12	000	002	0.03	0.(30	0.00	0,00	0.00	0.00	000	0,00	0,07	3.25
Minyr	1977	1920	1920	1966	1904	1922	1969	1967	1975	1972	1929	1976	1935
Avg M	1.29	096	068	0.46	0.54	0,65	0,24	0.26	0.51	0.59	1.29	145	8,9I
M Std	080	0,68	063	044	0.44	0.79	0.34	0.37	0.52	0.46	0.96	0.8I	245
MSkw	1.24	0.92	2.15	1.52	1.22	3.36	2. I5	2.30	1.90	0.77	1.07	045	036
5.t Kur	5.40	367	7.90	5.47	4.42	15.59	7.44	8.I3	7. i0	2.54	3.46	2.36	404

’Fable A-2

Station BUMPING LAKE

Id	969	Latitude 46:52:00		Parameter	Rain
Elevation	3440	Longitude 121:18:00		Coverage	96.73%
Begin Date 1/1931		End Date 6/1967		Record Cnt	37

Summary of Precipitation. in inches

	Jan	Feb	Mar	Apr	May	Sun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
DCnt	1115	1017	1116	1080	1109	1109	1116	1116	1080	1107	1042	1083	13090
D Avg	0.25	0.21	015	0.08	006	0.05	0.02	0.02	0.05	0.14	0,24	0.30	O.13
M Cat	36	36	36	36	36	37	36	36	36	36	35	35	34
Ma× M	16.56	13.30	0.49	5.96	4.62	4.41	1.65	1.88	5.3I	10.71	1585	2769	68.70
Ma×yr	1953	1961	1950	1958	1948	1937	1966	1963	1959	1947	1958	1933	1950
Min M	1.56	1.56	0,31	0.21	0.38	0.19	0.08	000	0.I1	0.2I	040	2.28	2635
Minyr	1963	1934	1965	1956	1947	1940	[945	1955	1932	1936	1936	1944	194a
Avg M	7.80	594	4.76	2.40	I 85	1.57	0.59	0.72	1.51	4 19	7.24	9.24	4785
M SId	4 14	306	2 40	1.50	1.09	0.92	0.46	0.56	1.05	2.58	4 14	4 51	1108
M Skw	0.42	0.71	0. 13	0.54	0 98	0.83	0.70	0.68	1.35	1.05	0.22	2.03	O 01
M Kur	2.02	2.48	197	2.27	2.93	3.55	2.06	2.13	5.56	3.45	1.92	8 63	1.95

Table A-3

Station NEWPORT

ld	58,14	Latitude	48:11:00	Parameter	Rain
Elevation	2140	Longitude	117:03:00	Coverage	99%
Begin Date 1/1927		End Dale	12/1986	Record Cat	60

Summary of Precipitation. in inches

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
D Cat	1857	1686	1843	I795	1848	I799	I857	1838	1797	1836	1786	1838	21780
D Avg	Oil	0,09	0.07	006	0.07	0,06	0.03	0.03	0.05	0.07	0.12	0.12	0.07
M Cnt	60	59	59	60	60	60	60	59	60	59	60	59	55
Max M	7.86	593	5.54	4.47	5.73	4.68	3.16	3.56	7.92	8.25	8.19	6.94	37.40
Maxyr	1953	1949	I945	1956	1984	198I	1978	1976	1927	1951	1960	I977	1950
Min M	0.02	0.23	0.10	0.29	0.29	0.56	0.00	0.00	0.00	0.08	0.09	0.80	1624
Mmyr	1985	1929	1965	1977	1958	1974	1985	1969	1975	1974	1929	1985	1944
Avg M	3.33	2.57	2.31	1,76	2.03	1,87	0.85	I.O0	1.50	2.24	3.54	3.78	27.15
M Std	1.74	[.39	1.12	1.03	1.36	096	0.78	0.92	1.31	1.69	1.88	1.43	5.02
M Skw	059	0.73	0.59	0.54	1.I4	0.78	1,00	0.94	2.27	146	0.34	0.13	-3.14
M Kur	296	292	3,28	2.55	3,27	304	3.35	2.85	10.53	527	2.48	2.36	2.30

Table A-4

Station MOUNT SPOKANE SUMMIT

Id	5674	Latitude	47:85:00	Parameter	Rain
Elevation	5890	Longitude	117:07:00	Coverage	95%
Begin Dale 7/I953		End Date	12/I972	Record Cnt	20

Summary of Precipitation, in inches

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
D Cnt	550	532	588	568	589	570	613	589	570	620	591	589	6036
D Avg	0.19	016	0 16	0. I2	009	0.09	0.04	0.05	0.09	0.12	020	0.20	0.13
M Cnt	18	19	18	19	19	19	20	19	19	20	20	19	16
Mt, x M	10.10	13.20	9 35	7.50	7.19	6.78	3.76	3.62	9.64	7.16	13.26	14 01	57.64
Maxyr	1964	196I	1966	1955	1959	1970	1955	1956	1959	1956	1960	1955	1961
MinM	1.3I	1.85	0.35	0,40	0.55	0.69	0.00	0.00	0.24	0.22	0.90	1.98	33.85
Minyr	1963	1964	1965	I957	1958	1960	1962	1969	1967	1965	1956	1960	1957
Avg M	5.83	4.61	4.94	3.49	2.78	2,7I	1,25	1.54	2.75	3.71	6.05	6.25	47.37
M Std	2.46	2.9t	2.50	2.08	1.75	1.40	1.26	1.29	2.23	2.05	3.10	285	780
M Skw	-0.08	1.68	-0.02	0. I4	1.09	1.24	0.73	0.37	1,79	0.14	0.50	083	-0.46
M Kur	201	4.64	192	200	3.17	4.42	1.98	1.46	5.33	1.64	2.59	3.67	I 71

Table A-5

Station ELLENSBURG

Id 2505
Elevation 1480
Begin Dare I/I901

Latitude 48:58:00
Longitude 120:33:00
End Date 12/1986

Parameter Snow
Coverage 94.56%
Record Cnt 75

Summary of Snowfall. in inches

	Jan	Feb	Mar	Apt	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
D Cat	2177	2003	2200	2100	2200	2160	2262	2200	2158	2229	2093	2159	25041
D Avg	0.31	0.17	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0,00	0.11	0.30	0 08
M Cnt	71	71	71	70	71	72	73	7I	72	72	70	70	61
Max M	28.00	36.00	8.50	4.20	0.00	0.00	0.00	0.00	0.130	1.O0	28.30	32.20	71.50
Maxyr	1921	1916	1904	1974	1986	1986	1986	1986	1986	1973	1955	1902	1921
Mm M	0.130	0.O0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.O0	000	0.30
Minyr	194I	1977	1986	1986	1986	1986	1986	1986	1986	1986	1981	1954	1934
AvgM	9.57	5.00	1.26	0.17	0.00	0.00	0.00	0.00	0.00	0.01	3.15	9.15	28.76
M Std	7.23	6.03	2.13	0.73						0.12	6.12	7.18	1505
M Skw	0.68	2.68	1.78	4.85						8.49	2.84	109	0.86
M Kur	2.60	12.20	5.03	24.25						68.08	999	398	384

Table A-6

Station BUMPING LAKE

[d	969	Latitude	4652:00	Parameter	**Snow**
Elevation	3440	Longitude	121:18:00	Coverage	37
Begin Date 1/1931		End Date	6/1967	Record Cnt	37

Summary of Snowfall, in inches

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
DCnt	1115	1017	1115	1080	1111	II09	1116	)116	1079	1105	1042	1074	13079
D Avg	1.96	1.45	I.I4	0.30	012	0.00	0.00	0.00	003	0.11	0.90	163	063
M Cnt	36	36	36	36	36	37	36	36	36	36	35	35	
Max M	I82.50	9000	76.00	45.50	100.60	0.50	0.00	0.00	1.00	I5.00	99.50	140.00	38100
Maxyr	1954	1949	1956	1955	1958	1952	1966	1966	1955	1961	I955	1948	1955
Min M	900	320	2.00	0.00	0,00	0.00	0,00	0.00	0.00	0.00	0.(30	000	91.60
Minyr	!945	1934	1934	1934	1959	!967	I966	1966	1966	I959	1936	1960	1941
AvgM	60.82	4142	3525	9.09	3.74	0.01	0.(30	0.00	0.10	3.44	26.69	50.17	231.93
M 5td	41.44	20.62	21.06	966	16.66	0.08			0.29	4.77	25.20	34.06	81.62
M Skw	I27	034	0.13	1.99	5.93	*6.08*			2.83	1.22	1.20	0.49	0.23
M Kur	3.97	2.57	1.71	667	31.71	33.16			8.13	2.92	3.52	2,49	204

Table A-7

Station NEWPORT

Id	5844	Latitude	48:11:00	Parameter	Snow
Elevation	2140	Longitude	117:03:00	Coverage	99 %
Begin Date 1/1927		End Date	1211986	Record Cnt	60

of Snowfall. in inches

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
D Cnt	1856	1666	1843	1795	1847	1799	1857	1838	1797	I856	1787	1837	21778
D Avg	0,68	038	0.14	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.22	057	017
M Cnt	60	59	59	60	60	60	60	59	60	60	60	59	55
Max M	73.00	3880	19.50	4.80	1,00	0.00	0.00	0,00	0,00	10.0(3	30.40	4800	[2970
Maxyr	1969	1949	I957	1955	1955	1955	1955	1986	1986	I957	1973	1 951	I 950
Mm M	00:3	0.00	0.00	0 O0	0.00	0.00	0,00	0.00	0,00	0.00	000	000	0 O0
Minyr	I939	1939	1981	1979	1984	1986	1986	1986	1986	1986	1981	1939	I939
Avg M	21.10	11.0l	434	0.35	0.02	0.00	0.00	0.00	0.00	046	661	17 65	81.73
M Std	1646	8.72	4.90	1.00	0.13					1,51	7.78	1252	3233
M Skw	1.21	097	1.25	3.30	7.75					4.89	124	002	0.16
M Kur	4.29	3 50	361	12.50	56.10					27.54	3 62	2.53	2.56

Table A-8

Station MOUNT SPOKANE SUMMIT

ld	5674	Latitude	4'7:55:00	Parameter	Snow
Elevation	5890	Longitude	117:07:00	Coverage	90%
Begin Date 7/1953		End Date	I2/'1972	Record Cnt	20

Summary of Snowfall, in inches

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
D Cnt	488	503	489	531	558	569	613	588	568	620	535	554	6619
D Avg	1.20	073	0.84	0.37	016	002	0.01	0.00	0.06	0.26	0.65	105	0 43
M Cat	16	18	16	18	13	19	20	19	19	20	I8	IS	12
Max M	95.50	39.50	63.00	23.50	23 50	6.00	2.00	0.00	TOO	29.10	11,20	73~0	207 80
Maxyr	1954	1961	1966	1959	1959	1966	I954	1953	1972	I956	1960	1964	1064
Min M	720	830	150	000	0.00	0,00	0.00	0,00	0.00	0.00	4.00	750	8500
Minyr	I963	1964	1965	1963	I963	1972	1972	1972	1970	1965	I956	1963	1963
AvgM	3912	2049	25.86	I0.86	5.01	0.63	0.20	003	1.87	8.08	1823	3219	16468
M Std	22.15	0.12	15.93	889	6.16	1.45	0.55		2.38	722	10.63	1719	3760
M Skw	I08	0.82	0.58	1.52	1.87	3.22	282		0.94	129	0.56	080	-0 78
M Kur	327	280	2.65	4.25	497	1003	7.44		2.02	4.10	213	276	2 13

Table A-9

Station **ELLENSBURG**

Id	2505	Latitude	46:58:00	Parameter	T Max
Elevation	1480	Longitude	120:33:00	Coverage	96.25%
Begin Date 1/1901		End Dale	12/1986	RecordCnt	75

Summary of Minimum Temperature. in degrees Fahrenheit

	Jan	Feb	Mar	*Apt*	May	Jun	Jul	Aug	Sep	Oct	Nov	*Dec*	Annual
D Cm	2266	2088	226I	2130	2230	2155	2260	2184	2153	2227	2158	2250	26402
D Avg	18	23	28	34	41	48	53	51	43	34	27	21	35
M Cnt	73	74	73	71	72	72	73	71	72	73	72	73	S8
Max M	31	33	33	42	47	54	29	26	48	41	34	31	a0
Maxyr	1981	1958	1905	1934	1957	1969	1975	1958	1966	1934	1934	1925	[034
Mm **M**	|	**4**	23	28	37	43	47	46	38	28	11	4	31
Minyr	1907	1936	1912	[982	1920	1906	1916	1911	1913	1916	1985	1983	1985
M **Scd**	?	2	3	2	2	2	2	2	2		4	6	2

Table A-10

Station	BUMPING LAKE				
ld	969	Latitude	,16:52:(X)	Parameter	T Max
Elevation	3440	Longitude	121:18:00	Coverage	95.28%
Begin Date 111931		End Date	6//967	Record Cnt	37

Summary of Maximum Temperature, in degrees Fahrenheit

	Jail	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annum
D Cnt	1113	1016	1115	1080	Ill0	1106	1114	1115	1079	1075	1037	1069	13029
D Avg	33	38	42	50	59	64	74	74	68	57	42	35	53
M Cut	36	36	36	36	36	37	36	36	36	35	35	34	33
Max M	40	46	53	60	68	75	82	83	77	70	52	33	56
Maxyr	1934	1963	1934	1951	1958	1961	1960	1961	1943	1952	1936	1939	1934
Min M	22	27	35	42	50	57	65	67	58	50	34	28	50
Minyr	1950	1936	1935	1955	1933	I953	1932	1937	I933	1947	1955	1948	1955
M Std	4	4	4	5	4	4	4	4	5	4	4	3	2

Table A-11

Stahon NEWPORT

Id	5844	Latitudc 48:[1:00		Parameter	T Max
Elevation	2140	Longitude 117:03:00		Coverage	99%
Begin Date 1/1927		End Date 1211986		Record Cnt	60

Summary of Maximum Temperature, in degrees Fahrenheit

	Jan	Feb	Mar	Apt	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
D Cnt	1848	1683	1832	[791	1838	1838	1851	1800	1781	1844	1784	I833	21681
D Avg	31	39	48	59	69	69	86	84	73	58	41	33	58
M Cnt	60	59	59	60	60	60	60	58	59	59	60	59	54
Ma× M	41	46	58	69	79	79	94	93	85	69	48	40	61
Maxyr	1953	1968	1941	1934	1958	I938	1985	1967	1967	1944	1941	1939	I938
Min M	16	24	40	50	62	70	76	76	61	52	28	23	55
Minyt	1937	1936	1955	1955	1955	1954	1983	I964	1986	I951	I985	1983	1955
M Std	5	4	4	4	4	3	4	4	6	4	3	3	2

Table A-12

Station	MOUNT SPOKANE SUMMIT				
Id	5674	Latitude 47:55:00		Parameter	T Max
Elevation	5890	Longitude 117:07:00		Coverage	91%
Begin Date 7/1953		End Date 12/1972		Record Cnt	20

Summary of Maximum Temperature, in degrees Fahrenheit

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	De~:	Annual
D Cat	531	490	556	534	577	555	592	564	539	592	557	548	6635
D Avg	24	28	30	38	49	57	67	66	56	44	32	26	43
M Cat	18	16	17	17	19	19	20	18	19	19	18	19	10
Max M	31	35	35	44	59	67	74	75	67	49	39	32	46
Maxyr	1961	1963	1968	1956	1958	1961	1957	1967	1967	1958	1954	1958	I957
Mm M	16	22	23	30	42	52	61	59	48	38	28	I$	40
Minyr	I972	1955	1955	1970	1955	1974	I955	1968	1972	I956	1968	1972	1972
M Std	4	4	3	4	5	4	4	5	5	3	3	4	2

Table A-13

Station ELLENSBURG

Id	*2505*	Latitude	46:58:00	Parameter	T Max
Elevation	1480	Longitude	120:33:00	Coverage	96,32%
Begin Date 1/1901		End Date	12/1986	Record Cnt	75

Summary of Maximum Temperature. in degrees Fahrenheit

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
D Cat	2278	2087	2262	2129	2228	2159	2257	2192	2153	2257	2159	2261	26422
D Avg	34	42	53	62	70	76	84	83	74	62	46	36	60
M Cat	74	74	73	71	72	72	73	71	72	73	72	73	68
Max M	45	53	63	73	79	86	92	91	83	70	55	43	66
Msxyr	I934	1934	1934	1934	1924	1922	1985	1967	1967	1907	1929	1953	1934
Min M	21	27	43	54	62	68	77	76	66	53	31	21	56
Mhlyr	1916	1936	1904	1955	I984	I901	I902	1907	1901	1905	1985	1985	1955
M S/d	5	5	4	4	4	4	4	4	4	3	4	5	2

Table A-14

Station BUMPING LAKE

Id	969	Latitude 46:52:00		Parameter	T Min
Elevation	3440	Longitude 121:18:00		Coverage	37
Begin Date 1/1931		End Date 6/1967		Record Cnt 37	

Summary of Minimum Temperature, in degrees Fahrenheit

	Jan	Feb	Mar	Apt	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
D Cat	1113	1017	1116	1080	1111	1105	1116	1114	1080	I076	1042	1060	13030
D Avg	14	16	20	26	32	38	42	4I	36	30	23	19	28
M Cnt	36	36	36	36	36	37	36	36	36	35	35	33	32
Max M	27	28	26	33	40	44	46	46	40	35	31	27	32
Maxyr	1953	1958	1934	19114	1938	1958	1958	1965	1940	1940	1965	1933	1958
Min M	-7	2	14	18	23	31	35	35	27	21	15	9	23
Minyr	1949	1936	1950	!950	1950	1950	1950	1950	I950	1949	1961	195I	1949
					3	2	2	2	3	2	4	5	2

Table A-15

Station NEWPORT

id 5844
Elevation 2140
Begin Date 111937

Latitude 48: 1 l:CO
Longitude 117:03:00
End Date 12/1986

Parameter T Min
Coverage 99%
Record Cnt 60

Summary of Minimum Temperature, in degrees Fahrenheit

	Jan	Feb	Mat	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
D Ca/	1855	1684	1826	1785	1836	1782	1850	1837	1793	1834	1754	1828	21664
O Avg	17	21	25	30	37	43	46	44	38	32	27	21	32
M Cnt	60	59	59	59	60	59	60	59	60	58	59	59	53
Max M	30	31	32	34	44	49	5]	50	46	39	35	29	35
Maxyr	[953	1958	1986	1974	1980	1958	1975	1977	1940	1940	1934	1980	I981
Min 61	-8	0	17	25	33	37	40	36	32	25	16	9	29
Minyr	1937	1936	1965	1951	I935	1940	1947	1947	1932	1974	1929	1927	I932
M Std	8	6	3	2	2	3	2	3	3	3	4	5	I

Table A-16

Station MOUNT SPOKANE SUMMIT

Id	5674	Latitude 47:55:00		Parameter	T Min
Elevation	5890	Longitude 117:07:00		Coverage	91%
Begin Date 7/1953		End Date I2/i972		Record Cat 20	

Summary of Minimum Temperature, in degrees Fahrenheit

	Jan	Feb	Mar	Apt	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
D Cat	530	499	573	541	556	550	594	568	539	592	557	550	6649
D Avg	14	I8	19	25	35	41	49	48	4I	31	22	16	30
M Cat	18	17	I8	18	18	19	20	19	19	19	18	19	11
Max M	22	26	25	31	43	49	58	56	50	37	28	21	34
Maxyr	[958	1958	1968	1956	I958	1961	1960	1967	1967	1953	1954	1958	1958
Min M	4	12	I]	20	29	36	44	42	34	27	16	6	29
Minyr	]963	1955	1955	1970	1955	1954	1963	1964	1972	1968	I959	1968	1972
M Std	5	4		3	4	3	3	4	5		3	4	2

’Fable A-17

Station MANASTASH CREEK NEAR ELLENSBURG. WASH

Parameter low (cfs)		Drainage Area	745
Year	909-1914	Gage Datum	2118
Latitude	46:58:00	Hydrolog Unit	17030001
Longitude	120;41:40	Agency	USGS

	Oct	Nov	Dec	Jan	Feb	Mar	Apt	May	Jun	Jul	Aug	Sep	Year
D Max	20.0	244.0	1130	64.0	560	892.0	462.0	415.0	397.0	88.0	35.0	lOS.0	892.0
l.s.d.	14.5	38.0	305	35.8	31.3	214.4	204.2	240.7	162.9	44.6	18.3	I4.2	78.9
DAv8	124	23.8	19.7	24.7	23.5	102.2	135.7	175.3	113.0	34.0	15.8	13.0	60.0
I sd.	10.2	9.6	89	I3.7	15.6	-10.1	67.2	109.9	63.2	23.3	13.3	11.7	41.1
D Min	84	9.0	70	100	9.5	13.0	31.0	66,0	41.0	16.0	6,0	7.2	6.0
M Std	21	14.2	10.8	11 I	7.9	112.2	68.5	65.4	49.8	10.7	2.5	1.2	18.9

Table A-18

Station NANEUM CREEK NEAR ELLENSBURG. WASH.

Parameter flow (cfs)		Drainage Area	69.5
Year	957-1978	Gage Datum	2480
Latitude	47:07:37	Hydrolog Unit	17080001
Longitude	120:28:47	Agency	USG8

	Oct	Nov	De<:	Jan	Feb	Mar	Apt	May	Jun	Jul	Aug	Sep	Year
D Max	37.0	304.0	253.0	210.0	200.0	254.0	263.0	593,0	654.0	202.0	71.0	37.0	654.0
+ i sd.	21.5	299	4'7.7	38.5	47.8	60.6	123.9	274.6	217.6	69.5	33.7	23.2	75.7
D Avg	17.6	21.7	284	26.1	32.1	39.3	86.2	197.2	145.6	47.8	25.1	18.6	57.9
i sd.	137	I3.5	9.0	13.7	16.5	17.9	48.6	119.9	73.6	26.1	16.6	14.0	40.2
D Min	8.3	6.5	7.6	9.0	13.0	12.0	15.0	24.0	I5.0	10.O	5.1	6.9	5.1
M Std	39	8.2	19 4	124	15.7	21,3	37.6	77.4	72.0	21.7	8,5	4.6	17.7

Table A-19

CALISPELL CREEK NEAR DALKENA. WASH.

Parameter flow (cfs)		Drainage Area	68.3
Year	50 - 1974	Gage Datum	2070
Latitude	48:1.1¸40	Hydrolog Unit	17010216
Longitude	117:20:26	Agency	USGS

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
D Max	I08.0	3690	36.4 0	462.0	848.0	744.0	988.0	671.0	256.0	127.0	36.0	460	988.0
* 1 s.d.	21.2	345	556	52.,1	98.2	127.8	348.6	299.9	100.7	38.0	19.6	18.0	89.3
D Avg	16.9	23.5	32.7	33.7	535	79.7	238.5	224.6	76.0	29.1	15.3	14.5	69.3
- I s.d.	12 6	125	9.9	15.1	8.8	31.7	128.5	I49.4	51.4	20.2	11.0	II0	49.4
D Min	38	39	3 2	2.8	8.0	II.0	24.0	46.0	t0.5	4.6	3.7	3.5	2.8
M Std	43	11.0	228	18.6	44.7	48.1	I I0.1	75.3	24.6	8.9	43	3.5	20.0

Appendix B. Slope Data Base anti Channel Profiles

Appendix B. Slope Data Base and Channel Profiles

In Taneum Creek Watershed slope data was obtained from the Slope overlays. Cells on the slope overlay contain a 4-digit number, of which the first digit is the slope class and the remaining three digits the unique cell identification number. The minimum size of the areas delineated is 5 acres. The following key explains the information in the Slope database.

WRIA#: Water Resource Inventory Area number

WATERSHED: Name of subwatershed

SLOPE: Slope class determined from USGS topographic map where,

1 = 0% to 5%
2 = 5% to 30%
3 = 30% to 65%
4 = 65% to 90%
5 :: >90%

CELL: Three digit cell identification number

ACRES: Measured size of area, in acres

Slope classes in Tacoma Creek Watershed were determined from the Soil Survey Report (WADNR 1975) and included in the soils database for Tacoma Creek.

Channel profiles were determined by measuring the distance between contour lines on 7-1/2 minute USGS topographic maps. Tables B-1 and B-2 contain the channel profile data for Taneum Creek and Tacoma Creeks, respectively.

Table B-I

TANEUM CREEK - Channel Profile

Elevation	Mainstem Increment feet	River mile
1700	0	0
1720	1000	0 2
1740	11043	04
1760	1050	06
I780	I000	0 8
1800	1500	1.1
I820	I0CK)	I3
1840	1050	I 5
1860	1503	1.7
1380	20(30	2 I
1900	1000	2 3
1020	*3000*	*2.9*
1960	1050	3 I
2000	4000	3 S
2940	2550	4 3
2080	2100	4 7
2120	24$0	5 2
2160	4300	60
2200	3750	67
2240	*2050*	*7 I*
2280	2450	7 6
232O	2150	80
2360	2000	83
2400	1900	87
2440	2000	9 1
2480	2000	9.5
2520	3400	10.1
2560	3000	10.7
2600	2500	I1.1
2640	1050	11.3
2680	1250	l 1.6
2720	2500	I2.I
2760	2550	t2 5
2300	3950	18.3

Elevation	South Fork Increment feet	River mile	North Fork Increment feet	**River** mile
2340	1500	13.6	1000	13.5
2880	2000	13.9	2500	13.9
2920	2000	14.3	2500	14.4
2960	1500	I4.6	1750	I4.8
3000	2050	I5.0	1500	15.0
3040	1500	15.3	1750	15.4
308'3	1000	15.5	2500	15.8
3120	!500	15,8	1500	16.[
3160	1050	16.0	1800	16.5
32CO	1500	16.2	2750	17.0
3240	500	I6.3	IS00	17.3
3280	530	16.4	1050	175
3320	500	16.5	1300	17.7
3360	500	16.6	1500	180
3400	600	16.7	1250	18.2
3440	1003	16.9	500	18.3
3480	2000	I7.3	I500	18.6
3520	5900	18.4	1600	18.9
3560	I250	18.7	2000	19.3
3600	1500	18.9	1500	19.6
3640	800	19.1	2000	20.0
3680	750	19.2	I000	20.2
3720	650	I9.4	900	20.3
3760	900	19.5	1500	20.6
3800	850	19.7	1900	21.0
3840	I003	19.9	I750	21.3
3880	500	20.0	1450	21,6
3920	600	20.1	I050	21.8
3960	500	20.2	1000	. 22.0
4000	500	20.3	1750	22.3
4040	1000	20.5	1450	22.6
4080	[000	20.7	1250	22.8
4120	800	20.8	1000	23.0
4160	500	20.9	1250	23.2

Elevation	South Fork increment feet	**River** mile	North Fork Incrcment	River rode
4200	550	21.0	1250	23.5
4240	5OO	21.I	1000	237
4280	750	21.2	500	23.8
4320	250	21.3	1000	239
4360	25O	21.3	1000	24.[
4400	500	214	I000	24 3
4440	50O	21.5	I700	24.6
4480	50O	21.6	1500	249
4520	500	21.7	20OO	25.3
4560	500	21.8	803	25.5
46O0	50O	21.9	1050	25.7
4640	500	220	5O0	257
4680	5O0	22.1	500	25. 8
472O	500	22.2		
4760	500	223		
4800	5OO	224		
4840	5OO	22.5		
4880	50O	22.6		
4920	50O	22.7		
4960	5O0	22.8		
5OOO	50O	22.9		
5200	2OOO	23.2		

Table t3-2

Tacoma Creek Channel profile

Elevation	Increment feet	River mile
2030	0	0
2040	5OO0	095
2080	3250	I 56
2120	I250	t 80
2[60	450	I 88
2200	1009	2 07
2240	550	2 18
2280	1000	2 37
2320	6500	360
2360	4000	436
2400	3900	5 09
2440	3500	5 76
2480	I750	6(7)
2520	3500	675
2560	200O	7.13
2600	3000	7.70
2640	2000	808
2680	3000	865
2720	25O0	912
2760	24O0	9.57
2800	1850	992
2840	2500	]040
2880	1500	10.68
2920	1500	1097
2960	1400	I 1.23
30,20	2950	11.79
3040	1750	12.12
3080	750	1226
3120	950	1244
3160	1000	12.63
3200	1000	12 82
3240	*550*	12 93
3280	450	!501
332O	250	13 06
3360	5OO	13.15
3400	15000	13.44
3440	1350	13.6!)
348O	1000	13.88
3520	1500	14.17
3560	1000	I4,36
36OO	40O	14.43
3640	1100	14.64
3680	]100	14.85
3720	1000	15.04
3760	750	15.18
3800	5OO	15.27
3840	70O	15.41
3880	1000	15.60
3920	I100	15.80
3960	500	I5.90
4000	500	15.99
4040	9OO	16.16
4080	1050	16.36
4120	400	16.44
4160	750	16.58
4200	40O	1666
4240	500	16.75
4280	750	16.89
4320	1250	I7.13
4360	1450	17.41
4400	750	17.55
4440	50O	17.64
4480	90O	I7.81
4520	650	17.94
4560	550	18.04
46O0	5OO	18.13
4800	1950	18.50
5OOO	25O0	1898
520O	3250	19.59
54OO	1500	I9.88
5600	II0O	20.09
580O	1500	20.37
596O	1050	20.57

Appendix C. Soils Database Description

Appendix C. Soils Database Description

The Soils data base reflects information described in the State Survey Report for the Ozette and Straits districts (WDNR, 1974). The State Soil Mapping Units are based on an average of the most common soil properties, climate characteristics, topographic features, etc., found on the soil unit. The Soils data base provides information from the State Soil Survey Report regarding natural and disturbed stability characteristics of each mapping unit. However, the data base does not include all rating categories listed in the report. Included in the Soils database are the following parameters:

WRIA#:	Water Resource Inventory Area number.
Subwatershed:	Name of study watershed.
Quad:	Name of USGS 7 1/2 minute quadrangle.
Map symbol:	State soil symbol number, as shown on Soil overlay.
Acres:	Area, as measured on Soil overlay.
Soil name:	State soil name.
Index Spp:	Dominant tree species.
Site index:	Reflects a measurement of forest quality based on the most commonly observed tallest tree species, and it's average height within a certain age.
Depth:	Average depth of mapping unit, in inches.
Drainage:	The natural drainage capacity of soils is determined by saturation frequency and duration during soil formation. Drainage capacity is defined by seven classes; excessively, somewhat excessively, well, moderately well, somewhat poorly, poorly, and very poorly drained. These classes describe the rate of water movement throughout the soil. Most of the soil mapping units in this study are either well or moderately well drained.
Nat Stab:	Natural slope stability refers to the undisturbed state of a slope under normal climatic circumstances. The natural slope is rated as stable or unstable based on significant problems with soil

properties, underlying material, drainage, and natural slope failures (e.g, landslides). If no significant problems in any of the above factors are present the slope is deemed as stable. An unstable slope rating will be assigned if any or some of the above stated problems are found to occur in a natural slope.

Dist Stab: Disturbed slope stability refers to slopes that have been impacted by human activities. These slopes are rated as stable if no significant stability problems arise as the result of road construction or timber harvesting. An unstable rating is based on the presence of slope related problems that can be overcome or minimized by applying current road construction technology and maintenance, or by implementing alternatives. Very unstable ratings are assigned to slope stability problems that cannot be entirely corrected by the application of current technology.

Rd Ero Haz: The ratings of cut, fill and sidecast hazards due to road construction are based on the areas soil properties, underlying material behavior, steepness of slope, soil drainage, and seasonal wetness. If the area is relatively level this rating does not apply. Slight ratings for road construction hazards can be overcome with standard road construction methods, and moderate hazard ratings can be reduced or minimized. Severe hazard ratings can only be reduced by special road construction methods.

TH Ero Haz: Timber harvest areas erosion potential is a result of water action on surface soils. The soil properties, rainfall, storm intensity, and slope interactions of an area define the amount of erosion that takes place. A low rating is assigned to an area where potential surface' erosion is minimal. Medium ratings indicate that erosion potential is significant and extensive erosion can occasionally occur; however, this can be reduced through careful logging practices. High ratings are given to areas where widespread surface erosion may frequently occur unless logging practices that minimize disturbances are applied.

Slope: (Only for Tacoma Creek Watershed)

1 + 0 to 5%
2 = 5 to 30%
3 = 30 to 50%
4 = >65%

Appendix D. Vegetation Database Description

Appendix D. Vegetation Database Description

The Vegetation overlay consists of numbered cells which delineate stand areas. Information pertaining to the vegetative characteristics of each of these cells is contained in the vegetation database for each watershed. Due to the large number of cells and the different format of available information, each watershed has a separate database. Both Taneum and Tacoma Creek databases contain the following items:

WRIA: Water Resource Inventory Area number

Sub: Study watershed name, where Tn = Taneum and Tc = Tacoma

Stand: Cell number, from the Vegetation overlay

Type: Primary land use, where

0i = residential/developed
02 = noncultivated pasture
03 = cultivated pasture
04 = gravel pit
05 = brush
06 = rock outcrop

10 = forest with no grazing
11 = forest with grazing
12 = powerline
13 = radio tower
14 = non-forested (naturally unstocked)
15 = highway right-of-way

20 = wetland
21 = stream corridor
22 = lake
23 = tidal flats

Acres: Stand acreage

Owner: Land owner, where
01 = Champion International Corporation
02 = Weyerhauser Company
03 = Washington Department of Natural Resources
04 = U.S. Forest Service

05 = Seaboard Lumber company
06 = Burlington Northern Corporation
07 = City of Tacoma
08 = Plum Creek Timber Company
09 = ITT Rayonier/Rayonier Timberlands
10 = Bloedel Timber
11 = MerilI and Ring
12 = Pope Resources
13 = NDC Timber
14 = Travelers Timber Investments
15 = Small landowner (did not provide data)
16 = Cavenham
17 = Washington Department of Wildlife

Legal: Township, range, and section

ID: Identification number assigned by the landowner

Comments: "aerial photo interp" means that the information was determined through use of aerial photos and extrapolation of data from adjacent and similar stands

"FS info - private land" means that the information was obtained from the U.S. Forest Service database, rather than the private owner.

For the Taneum Creek watershed, the following additional items are included in the "Tanveg" database:

Condition: An indicator of vegetation size and canopy closure including:

Washington Department of Wildlife Habitat Cover Types:

closed conifer = mature coniferous trees, 70% to 100% canopy closure, not harvested.

open conifer = mature coniferous trees, 45% to 70% canopy closure, including shelterwood harvest and naturally open stands.

woodland = young conifers and fields of bitterbrush, also included are areas with sparsely scattered large trees, often clearcuts or seed tree harvests.

deciduous = broadleaf species, often associated with riparian zone.

forage =: shrub, grass and forb communities, including moist, medium, dry, and sparse forage types.

U.S. Forest Service Vegetation Condition Categories:

regen = trees 0 to 4.5 feet tail, variable canopy closure, 0 to 10 years old.

seedling = trees 4.6 to 15 feet tall, variable canopy closure, 10 to 20 years old.

sapling := trees 15.1 to 30 feet tall, >50% canopy closure, 20 to 35 years old.

pole = trees 30.1 to 60 feet tall, >60% canopy closure, single story, not harvested.

pole 2 = trees 30.1 to 60 feet tail, <60% canopy closure, single story, not harvested.

pole 3 = trees 30.1 to 60 feet tail, >60% canopy closure, multistory, not harvested.

pole 4 = trees 30.1 to 60 feet tall, >60% canopy closure, multistory, not harvested.

mature = trees 614- feet tail, >70% canopy closure, not harvested.

shwood = trees 61+ feet tall, >60% canopy closure, partial cut.

shwoodc = trees 61+ feet tall, > 60% canopy closure, partial cut.

fnc = non-.commercial forest.

For the Tacoma Creek watershed, the following additional items are included in the "Tacveg" database:

Dom: Dominant species, where:

af = subalpine fir
cc = western red cedar
df = Douglas-fir
es = Engelman spruce
fnc = non-commercial forest
gf = grand fir
Ip = lodgepole pine
mix = mixed forest, no dominant distinguished
pp = ponderosa pine
wh = western hemlock

wl = western larch
wp = white pine

Subdom: subdominant species, where available.

Year: Year of origin, if available from existing inventories.

Note: Where year of origin was not available, stand age was estimated from 1986 aerial photos. In order' to distinguish these photo-interpreted stands from those with more exact inventories, the following entries were made:

60 = dominant trees are greater than 60 years old, less than 100 years old.

100 = dominant trees are greater than 100 years old,

Stands that appeared to result from regeneration following the 1920 to 1930s forest fires were listed as 1935 year of origin.

Prescrp: Harvest prescription, where available.

cc = clearcut
partial = partial cut
seedtree =: seed tree harvest
TSI = precommercial thin

Tables D-1 and D-2 are a list of the stands, according to type and year of origin, for Taneum Creek and Tacoma Creek watersheds, respectively.

Riparian Vegetation

The Riparian database contains information from the Vegetation overlay that pertains to the riparian corridor. Since the format of vegetation information available for the two watersheds was quite different, separate riparian databases were created. Both database includes the following parameters:

WRIA: Water Resource Inventory Area number

Subwatershed: Study watershed name, where Tn = Taneum and Tc = Tacoma

Stand: Number of the stand on vegetation overlay

Length: Linear distance along stream corridor, in feet

For the Taneum Creek watershed, the following additional items are included in the "Tanriprn" database:

Condition: condition classes as described in the vegetation database

Comments: Notes whether the stand is along the mainstem, North Fork, or South Fork of Taneum Creek

For the Tacoma Creek watershed, the following additional items are included in the "Tacriprn" database:

DomSpp: dominant species, where available.

df = Douglas-fir
es = Engehnan spruce
wh = western henfiock
wl = western larch
mx = mixed forest, no dominant tree species distinguished

Orig Year: year of origin, as previously described for the vegetation database.

Comments: observations from 1986 aerial photos, including whether vegetation is predominantly deciduous or hardwood and whether the riparian area is part of a buffer or clearcut.

Table D-1. Taneum Creek Vegetation Condition Report

01 RESIDENTIAL

TYPE	CONDITION	STAND	ACRES	LEGAL
1	res	11	6	18N17E04
1	res	12	4	18N17E05
1	res	13	3	18N17E05
1	res	14	10	18N17E04
1	res	15	5	18N17E04
1	res	16	4	18N17E04
1	res	2'7	8	18N17E06
1	res	28	12	18N17E06
1	res	30	8	18N16E01
		Total =	60	
	Total for type l =		60	

02 NONCULTIVATED PASTURE

TYPE	CONDITION	STAND	ACRES	LEGAL
2	deciduous	6	39	18N17E08
		Total =	39	
	forage	18	900	18N17E04
		Total =	900	
	Total for type 2 =:		939	

03 CULTIVATED PASTURE

TYPE	CONDITION	STAND	ACRES	LEGAL
3	crop	22	120	18N17E06
3	crop	43	17	18N16E06
		Total =	137	
	Total for type 3 =		137	

04 GRAVEL PITS

TYPE	CONDITION	STAND	ACRES	LEGAL
4	(gravel pit)	29	4	18N17E06
4		45	2	18N16E06
4		46	2	18N16E06
4		62	2	18N16E01
4		67	2	18N16E15
4		91	2	18N16E10
4		202	2	19N16E14
4		386	2	18N15Ell
4		388	2	18N15Ell
4		486	3	19N14E23
4		487	3	19N14E23
4		556	2	19N14E15
		Total =	28	
	Total for type 4 =		28	

05 BRUSH

TYPE	CONDITION	STAND	ACRES	LEGAL
5	(brush)	89	39	18N16Ell
5		98	36	18N16E03
5		112	32	18N16E10
5		125	34	19N16E33
5		130	9	19N16E29
5		137	31	19N16E32
5		159	48	19N16E20
		Total =	229	
5	deciduous	4	55	18N17E05
5	deciduous	5	3	18N17E05
5	deciduous	7	14	18N17E05
5	deciduous	8	10	18N17E05
5	deciduous	49	**4**	18N16E06
		Total =-	86	
	Total for type 5 =		315	

06 ROCK OUTCROPS

TYPE	CONDITION	STAND	ACRES	LEGAL
6	(rock outcrops)	63	18	19N16E36
6		64	10	18N16E12
6		65	4	18N16E12
6		66	4	18N16Ell
6		68	17	18N16Ell
6		75	2	18N16E02
6		76	6	18N16E02
6		77	10	18N16E02
6		83	14	19N16E35
6		84	88	19N16E34
6		87	4	19N16E34
6		92	11	18N16E03
6		97	9	18N16E03
6		122	3	18N16E09
6		123	5	18N16E09
6		127	6	19N16E33
6		128	10	19N16E33
6		133	3	19N16E29
6		134	8	19N16E28
6		138	5	19N16E32
6		139	10	19N16E32
6		140	9	19N16E29
6		141	3	19N16E32
6		142	8	19N16E32
6		143	28	18N16E05
6		145	25	18N16E05
6		146	10	18N16E05
6		149	60	19N16E32
6		163	25	19N16E31
6		164	41	19N16E31
6		165	10	19N16E31
6		166	6	19N16E30
6		167	5	19N16E31
6		231	10	19N15E25
6		232	13	19N15E24
6		245	1	19N15E23
6		261	8	19N15E34
6		286	5	19N15E36
6		289	12	19N15E36
6		294	1	19N15E36
6		298	19	19N15E36
6		303	6	19N15E35
6		305	6	19N15E35
6		308	3	19N15E35
6		315	14	19N15E34
6		348	11	18N15E02
6		362	5	18N15E04

TYPE	CONDITION	STAND	ACRES	LEGAL
6		363	13	18N15E04
6		368	3	18N15E04
6		369	5	18N15E04
6		371	4	18N15E05
6		372	6	18N15E05
6		374	2	18N15E03
6		376	27	18N15E03
6		390	3	18N15E09
6		40'7	4	19N14E26
6		413	2	18N15E06
6		415	3	18N15E06
6		416	26	18N15E06
6		417	4	18N15E06
6		418	8	18N15E06
6		420	4	18N15E08
6		421	7	18N15E08
6		423	5	19N14E36
6		426	3	19N14E36
6		429	2	19N14E36
6		435	6	19N14E34
6		436	40	19N14E34
6		437	2	19N14E34
6		440	33	18N14E03
6		441	6	18N14E03
6		443	5	18N14E03
6		450	124	18N14E02
6		454	18	18N14E02
6		456	74	18N14Ell
6		459	9	18N14E12
6		462	4	18N14E12
6		466	5	18N14E19
6		475	2	18N15E07
6		476	5	18N15E07
6		4-/7	2	18N15E07
6		478	15	18N15E07
6		485	3	19N14E23
6		493	33	19N14E27
6		499	1'76	19N14E20
6		505	1	19N14E33
6		506	48	19N14E33
6		5O9	3	19N14E22
6		512	7	19N14E32
6		5].4	13	19N14E30
6		522	15	19N14E31
6		530	4	19N15E18
6		534	9	19N14E14
6		535	3	19N14E14
6		543	6	19N15E19
6		557	11	19N14E09

PAGE: 5

TYPE	CONDITION	STAND	ACRES	LEGAL
6		560	3	19N14E16
6		569	10	19N14E33

Total for type 6 = 1417

10 FOREST/ NO GRAZING

TYPE	CONDITION	STAND	ACRES	LEGAL
10	fnc	190	19	19N16E14
10	fnc	205	23	19N16E22
10	fnc	283	22	19N15E25
10	fnc	285	14	19N15E36
10	fnc	292	7	19N15E36
10	fnc	310	16	19N15E35
10	fnc	312	6	19N15E35
10	fnc	316	14	19N15E34
10	fnc	323	12	18N15E01
10	fnc	329	4	18N15E12
10	fnc	332	14	18N15E12
10	fnc	335	3	18N15E12
10	fnc	337	60	18N15E02
10	fnc	343	14	i8N15E02
10	fnc	352	180	18N15E10
10	fnc	364	18	18N15E04
10	fnc	365	12	18N15E04
10	fnc	366	5	18N15E04
10	fnc	36'7	18	18N15E04
10	fnc	370	8	18N15E05
t0	fnc	375	8	18N15E03
10	fnc	377	5	18N15E03
10	fnc	382	18	18N15Ell
10	fnc	383	28	18N15Ell
10	fnc	392	20	18N15E09
10	fnc	402	33	19N15E30
10	fnc	405	5	19N14E26
10	fnc	406	4	19N14E26
10	fnc	408	25	19N14E26
10	fnc	410	7	19N15E32
10	fnc	412	15	18N15E06
10	fnc	414	8	18N15E06
10	fnc	424	20	19N14E36
10	fnc	425	71	19N14E36
10	fnc	430	22	19N14E36
10	fnc	446	11	18N14E01
10	fnc	447	40	18N14E01
10	fnc	449	20	18N14E02

TYPE	CONDITION	STAND	ACRES	LEGAL
10	fnc	461	4	18N14E12
10	fnc	463	4	18N14E12
10	fnc	469	12	18N14E31
10	fnc	470	6	18N14E31
10	fnc	474	10	18N15E07
10	fnc	482	16	19N14E25
10	fnc	490	26	19N14E27
10	fnc	492	44	19N14E27
10	fnc	494	7	19N14E27
10	fnc	501	5	19N14E29
10	fnc	510	29	19N14E22
10	fnc	531	6	19N15E18
10	fnc	544	20	19N15E19
10	fnc	549	11	19N14E13
10	fnc	559	26	19N14E16
10	fnc	561	27	19N14E17

Total = 1082

10	mature	173	55	19N16E24
10	mature	181	78	19N16E13
10	mature	194	9	t9N16E14
10	mature	210	9	19N16E15
10	mature	215	780	19N16E22
10	mature	218	1	19N16E22
10	mature	222	22	19N16E20
10	mature	229	7689	19N15E
10	mature	262	14	19N15E34
10	mature	263	23	19N15E34
10	mature	282	3	19N15E25
10	mature	302	3	19N15E36
10	mature	327	191	18N15E01
10	mature	330	4	18N15E12
10	mature	342	6	18N15E02
10	mature	345	48	18N15E02
10	mature	353	2	18N15E10
10	mature	354	91	18N15E10
10	mature	355	12	18N15E10
10	mature	356	18	18N15E10
10	mature	358	115	18N15E10
10	mature	359	109	18N15ElO
10	mature	378	410	18N15E03
10	mature	387	**58**	18N15Ell
10	mature	394	28	18N15E09
10	mature	395	257	18N15E09

TYPE	CONDITION	STAND	ACRES	LEGAL
10	mature	396	404	19N15E29
10	mature	399	84	19N15E20
10	mature	400	557	19N15E30
10	mature	403	520	19N14E24
10	mature	409	579	19N14E26
10	mature	419	765	18N15E06
10	mature	422	6	18N15E08
10	mature	432	345	19N14E34
10	mature	439	27	18N14E03
10	mature	444	99	18N14E04
10	mature	445	14	18N14E03
10	mature	448	1721	18N14E01
10	mature	452	17	18N14E02
10	mature	465	369	18N14E19
10	mature	468	93	18N14E29
10	mature	473	600	18N14E31
10	mature	479	244	18N15E07
10	mature	481	619	19N14E25
10	mature	483	640	19N14E35
10	mature	498	8	19N14E20
10	mature	503	63	19N14E29
10	mature	507	2053	19N14E22
10	mature	508	258	19N14E22
10	mature	511	90	19N14E32
10	mature	513	336	19N14E30
10	mature	519	60	19N14E29
10	mature	523	85	19N14E31
10	mature	524	48	19N14E20
10	mature	526	23	19N15E20
10	mature	532	149	19N15E18
10	mature	533	81	19N14E24
10	mature	536	498	19N14E14
10	mature	539	52	19N14E10
10	mature	541	6	19N14E10
10	mature	545	206	19N15E19
10	mature	546	3	19N15E19
10	mature	547	108	19N14E13
10	mature	551	20	19N14E13
10	mature	563	938	19N14E15
10	mature	564	5	19N14Ell
10	mature	565	37	19N14E20
10	mature	573	73	19N14E27

Total = 22938

PAGE: **8**

TYPE	CONDITION	STAND	ACRES	LEGAL
10	pole	517	83	19N14E20
		Total =	83	
10	pole2	464	33	18N14E12
		Total =	33	
10	pole3	257	123	19N15E28
10	pole3	279	34	19N15E35
10	pole3	301	5	19N15E36
10	pole3	306	28	19N15E35
10	pole3	401	69	19N15E30
10	pole3	404	18	19N14E24
10	pole3	411	265	18N15E06
10	pole3	427	13	19N14E36
10	pole3	428	14	19N14E36
10	pole3	431	54	19N14E34
10	pole3	433	108	19N14E34
10	pole3	438	180	19N14E34
10	pole3	453	37	18N14E02
10	pole3	457	11	18N14Ell
10	pole3	458	19	18N14Ell
10	pole3	471	8	18N14E31
10	pole3	472	30	18N14E31
10	pole3	489	61	19N14E27
10	pole3	491	21	19N14E27
10	pole3	500	14	19N14E20
10	pole3	502	56	19N14E29
10	pole3	540	44	19N14E10
		Total	1212	
10	pole4	434	58	19N14E34
10	pole4	442	71	18N14E03
10	pole4	455	12	18N14E02
10	pole4	467	23	18N14E19
		Total =	164	

TYPE	CONDITION	STAND	ACRES	LEGAL
10	regen	180	5	19N16E23
10	regen	182	10	19N16E13
10	regen	188	30	19N16E14
10	regen	193	18	19N16E14
10	regen	197	21	19N16E14
10	regen	198	2	19N16E23
10	regen	200	2	19N16E23
10	regen	203	22	19N16E14
10	regen	212	12	19N16E16
10	regen	221	69	19N16E17
10	regen	227	30	19N16E30
10	regen	230	8	19N15E25
10	regen	236	3	19N15E24
10	regen	239	2	19N15E23
10	regen	240	1	19N15E23
10	regen	241	3	19N15E23
10	regen	242	2	19N15E23
10	regen	244	8	19N15E23
10	regen	252	4	19N15E22
10	regen	253	2	19N15E27
10	regen	254	2	19N15E26
10	regen	255	1	19N15E26
10	regen	266	86	19N15E27
10	regen	267	12	19N15E26
10	regen	268	17	19N15E26
10	regen	269	9	19N15E26
10	regen	270	14	19N15E25
10	regen	271	14	19N15E26
10	regen	273	7	19N15E25
10	regen	275	17	19N15E25
10	regen	276	30	19N15E25
10	regen	278	7	19N15E35
10	regen	280	17	19N15E35
10	regen	281	5	19N15E36
10	regen	288	18	19N15E36
10	regen	290	8	19N15E36
10	regen	291	7	19N15E36
10	regen	293	13	19N15E36
10	regen	295	15	19N15E36
10	regen	296	28	19N15E36
10	regen	297	6	19N15E36
10	regen	300	18	19N15E36
10	regen	307	25	19N15E35
10	regen	309	15	19N15E35
10	regen	313	22	19N15E34
10	regen	314	5	19N15E34
10	regen	317	3	18N15E01
10	regen	318	8	18N15E01
10	regen	319	7	18N15E01

PAGE: 10

TYPE	CONDITION	STAND	ACRES	LEGAL
10	regen	321	13	18N15E01
10	regen	324	37	18N15E01
10	regen	325	25	18N15E01
10	regen	333	3	18N15E12
10	regen	336	8	18N15E12
10	regen	338	8	18N15E02
10	regen	339	6	18N15E02
10	regen	341	102	18N15E02
10	regen	344	6	18N15E02
10	regen	350	2	18N15E02
10	regen	373	188	18N15E03
10	regen	381	184	18N15Ell
10	regen	389	40	18N15E09
10	regen	393	100	18N15E09
10	regen	397	25	19N15E33
10	regen	398	30	19N15E26
10	regen	480	36	18N15E07
10	regen	484	35	19N14E23
10	regen	488	128	19N14E23
10	regen	495	95	19N14E27
10	regen	496	68	19N14E27
10	regen	497	373	19N14E21
10	regen	504	80	19N14E29
10	regen	520	66	19N14E29
10	regen	537	17	19N14E10
10	regen	538	9	19N14E10
10	regen	542	28	19N15E17
10	regen	548	10	19N14E13
10	regen	550	149	19N14E13
10	regen	553	3	19N14E13
10	regen	554	21	19N14E23
10	regen	555	231	19N14E15
10	regen	558	18	19N14E16
10	regen	566	115	19N14E21
10	regen	567	188	19N14E28
10	regen	568	59	19N14E33
10	regen	570	6	19N14E23
10	regen	57].	68	19N14E23
10	regen	572	130	19N14E27
10	regen	574	,40	19N15E29
10	regen	575	92	19N15E29
10	regen	576	9	19N14E15
10	regen	577	48	19N14E16
10	regen	578	48	19N14E17
10	regen	579	5	19N14E17

Total = 3642

PAGE: 11

TYPE	CONDITION	STAND	ACRES	LEGAL
10	sapling	184	8	19N16E14
10	sapling	187	18	19N16E14
10	sapling	191	13	19N16E14
10	sapling	195	4	19N16E14
10	sapling	201	65	19N16E14
10	sapling	211	25	19N16E16
10	sapling	214	29	19N16E16
10	sapling	217	42	19N16E22
10	sapling	220	21	19N16E21
10	sapling	238	18	19N15E23
10	sapling	246	23	19N15E22
10	sapling	247	2	19N15E22
10	sapling	249	4	19N15E21
10	sapling	265	42	19N15E34
10	sapling	274	18	19N15E25
10	sapling	277	6	19N15E35
10	sapling	287	6	19N15E35
10	sapling	299	9	19N15E36
10	sapling	304	23	19N15E35
10	sapling	311	8	19N15E35
10	sapling	320	437	18N15E01
10	sapling	347	43	18N15E02
10	sapling	351	38	18N15E02
10	sapling	357	8	18N15E10
10	sapling	360	18	18N15E10
10	sapling	552	31	19N14E13
10	sapling	562	76	19N14E17
		Total =	1035	

TYPE	CONDITION	STAND	ACRES	LEGAL
10	seedling	178	5	19N16E13
10	seedling	179	10	19N16E13
10	seedling	183	11	19N16E14
10	seedling	189	39	19N16E14
10	seedling	206	6	19N16E22
10	seedling	207	6	19N16E22
10	seedling	208	8	19N16E22
10	seedling	213	5	19N16E16
10	seedling	216	38	19N16E21
10	seedling	228	193	19N16E30
10	seedling	235	9	19N15E24
10	seedling	322	30	18N15E01
10	seedling	328	21	18N15E12
10	seedling	331	18	18N15E12
10	seedling	334	17	18N15E12
10	seedling	340	27	18N15E02
10	seedling	385	17	18N15E11
		Total =	460	

TYPE	CONDITION	STAND	ACRES	LEGAL
10	shwood	174	7	19N16E13
10	shwood	176	4	19N16E24
10	shwood	177	13	19N16E13
10	shwood	199	10	19N16E23
10	shwood	204	39	19N16E15
10	shwood	209	47	19N16E15
10	shwood	223	25	19N16E20
10	shwood	224	15	19N16E20
10	shwood	225	16	19N16E20
10	shwood	234	6	19N15E24
10	shwood	237	11	19N15E23
10	shwood	243	6	19N15E23
10	shwood	248	96	19N15E21
10	shwood	250	9	19N15E21
10	shwood	264	6	19N15E27
10	shwood	272	196	19N15E26
10	shwood	284	80	19N15E26
10	shwood	527	25	19N15E18
10	shwood	528	18	19N15E18
10	shwood	529	21	19N15E18

Total = 650

10	shwoodc	175	298	19N16E24
10	shwoodc	192	53	19N16E14
10	shwoodc	196	8	19N16E14
10	shwoodc	219	9	19N16E21
10	shwoodc	226	268	19N16E20
10	shwoodc	233	83	19N15E24
10	shwoodc	251	68	19N15E22
10	shwoodc	256	597	19N15E27
10	shwoodc	258	27	19N15E28
10	shwoodc	259	208	19N15E33
10	shwoodc	260	5	19N15E34
10	shwoodc	451	21	18N14E02
10	shwoodc	525	32	19N15E20

Total 1677

Total for type 10 = 32976

11 FOREST WITH GRAZING

TYPE	CONDITION	STAND	ACRES	LEGAL
11	closed conifer	39	128	18N16E01
11	closed conifer	61	15	18N16E01
11	closed conifer	70	18	18N16E14
11	closed conifer	72	5O	18N16E14
11	closed conifer	79	569	18N16E02
11	closed conifer	85	15	19N16E34
11	closed conifer	94	66	18N16E03
11	closed conifer	102	59	19N16E27
11	closed conifer	104	69	19N16E28
11	closed conifer	108	111	19N16E28
11	closed conifer	113	20	18N16E09
11	closed conifer	115	6	18N16E10
11	closed conifer	116	6	18N16E10
11	closed conifer	121	1.02	18N16E09
11	closed conifer	124	15	18N16E08
11	closed conifer	129	21	19N16E33
11	closed conifer	135	3O	19N16E29
11	closed conifer	144	55	19N16E34
11	closed conifer	156	10	18N16E08
11	closed conifer	169	25	19N16E19
11	closed conifer	170	22	19N16E19

Total = 1412

11	open conifer	9	16	18N17E08
11	open conifer	10	8	18N17E08
11	open conifer	25	77	19N16E36
11	open conifer	40	49	18N16E01
11	open conifer	41	46	18N16E01
11	open conifer	42	27	18N16E06
11	open conifer	47	8	18N16E06
11	open conifer	50	3	18N16E06
11	open conifer	51	11	18N16E01
11	open conifer	52	9	18N16E01
11	open conifer	53	691	18N17E07
11	open conifer	55	566	18N16E01
11	open conifer	56	15	18N17E06
11	open conifer	58	5	18N16E01
11	open conifer	59	3	18N16E01
11	open conifer	71	55	18N16E14
11	open conifer	88	7:[5	18N16Ell
11	open conifer	105	56	19N16E28
11	open conifer	107	38	19N16E28
11	open conifer	110	4	19N16E21
11	open conifer	132	289	19N16E20

PAGE: 14

TYPE	CONDITION	STAND	ACRES	LEGAL
11	open conifer	147	439	18N16E05
11	open conifer	151	83	18N16E05
11	open conifer	157	2592	18N16E04
11	open conifer	158	994	19N16E32
11	open conifer	160	84	19N16E19
11	open conifer	162	22	18N16E06
11	open conifer	172	32	19N16E19

Total = 6937

11	woodland	69	521	18N16E12
11	woodland	74	].88	18N16Ell
11	woodland	81	9	18N16E02
11	woodland	82	43	19N16E35
11	woodland	86	731	19N16E35
11	woodland	93	45	18N16E10
11	woodland	95	97	18N16E03
11	woodland	96	77	18N16E03
11	woodland	99	6	19N16E34
11	woodland	117	12	18N16E09
11	woodland	118	5	18N16E09
11	woodland	119	21	18N16E09
11	woodland	120	1.09	18N16E09
11	woodland	126	78	19N16E33
11	woodland	131	477	19N16E20
11	woodland	136	414	19N16E29
11	woodland	148	1.35	18N16E05
11	woodland	150	12	18N16E05
11	woodland	152	373	18N16E05
11	woodland	153	366	18N16E08
11	woodland	154	64	18N16E08
11	woodland	155	34	18N16E08
11	woodland	161	215	19N16E19
11	woodland	168	431	19N16E31
11	woodland	171	182	19N16E19

Total = 4645

Total[for type 11 = 12994

14 NON-FOREST (UNSTOCKED, NATURAL MEADOWS)

TYPE	CONDITION	STAND	ACRES	LEGAL
14	(nonforest)	515	211	19N14E30
14		516	38	19N13E24
14		518	382	19N14E20
14		521	115	19N13E25
		Total =	746	
14	forage	19	1500	18N17E05
14	forage	20	388	18N17E05
14	forage	21	224	18N17E08
14	forage	34	25	18N16E01
14	forage	35	8	18N16E01
14	forage	36	10	18N16E01
14	forage	37	3	18N16E01
14	forage	38	10	18N16E01
14	forage	48	55	18N16E06
14	forage	54	12	18N17E18
14	forage	57	4	18N16E01
14	forage	60	6	18N16E01
14	forage	73	151	18N16E14
14	forage	78	5	18N16E02
14	forage	90	247	18N16E10
14	forage	101	35	19N16E27
14	forage	103	22	19N16E28
14	forage	109	6	19N16E21
14	forage	114	62	18N16E10
		Total =	2773	
14	grass	326	10	18N15E01
		Total	10	
14	ncf	185	3	19N16E13
14	ncf	186	11	19N16E14
		Total =	14	

TYPE	CONDITION	STAND	ACRES	LEGAL
14	nonveg	346	18	18N15E02
14	nonveg	349	16	18N15E02
14	nonveg	361	5	18N15E10
14	nonveg	379	23	18N15Ell
14	nonveg	380	4	18N15Ell
14	nonveg	384	4	18N15Ell
14	nonveg	391	14	18N15E09

Total := 84

Total for type 14 = 3627

15 HIGHWAY RIGHT-OF-WAY

TYPE	CONDITION	STAND	ACRES	LEGAL
15	highway r.o.w,	17	80	18N17E05

Total = 80

Total for type 15 = 80

21 STREAM CORRIDOR

TYPE	CONDITION	STAND	ACRES	LEGAL
21	closed conifer	32	3	18N16E01
21	closed conifer	33	8	18N16E01
21	closed conifer	80	54	18N16E02
21	closed conifer’	100	111	19N16E34
21	closed conifer	111	133	19N16E29

Total = 309

TYPE	CONDITION	STAND	ACRES	LEGAL
21	deciduous	1	41	18N17E04
21	deciduous	2	20	18N17E04
21	deciduous	3	61	18N17E05
21	deciduous	26	39	18N17E06
21	deciduous	31	3	18N16E01

Total = 164

Total for Type 21 = 4’73

22 LAKES

TYPE	CONDITION	STAND	ACRES	LEGAL
22	(lakes)	23	2	19N17E31
22		24	1	19N16E36
22		44	2	18N16E06
22		106	1	19N16E28
22		460	5	18N14E12
		Total =	11	
	Total for type 22	=	11	

Total acres in watershed: 53,057

Table D-2. Tacoma Creek Vegetation Type Report

02 PASTURE

STA	TY	ACRES	LEGAL	OW
257	02	5	34N43E16	04
403	02	43	33N43E25	15
404	02	50	34N43E36	15
	TOTAL	98		

06 *ROCK* OUTCROP

STA	TY	ACRES	LEGAL	OW
42	06	62	34N43E04	04
90	06	20	34N43E06	04
110	06	14	34N43E08	04
122	06	19	34N43E08	04
123	06	15	34N43E08	04
].31	06	14	34N43E08	04
133	06	4	34N43E08	04
146	06	25	34N43E18	04
149	06	35	34N43E18	04
TOTAL		208		

10 FORESTED

STA	TY	ACRES	LEGAL	OW
1	10	245	34N42E02	04
2	10	70	34N42E02	04
3	10	10	34N42E02	04
4	10	31	34N42E02	04
5	10	23	34N42E02	04
6	10	115	34N42E02	04
7	10	5	34N42E02	04
8	10	25	34N42E02	04
9	10	23	34N42E02	04
10	10	17	34N42E02	04
11	10	63	34N42E02	04
12	10	90	34N42E12	04
13	10	18	34N42E12	04
14	10	20	34N42E12	04

15	10	136	34N42E12	04
16	10	245	34N42E12	04
17	10	29	34N42E12	04

10 FORESTED

STA	TY	ACRES	LEGAL	OW
18	10	24	34N42E12	04
19	10	19	34N42E12	04
20	10	30	34N42E12	04
21	10	61	34N42E12	04
22	10	33	34N42E12	04
23	10	40	34N43E07	04
24	10	40	34N43E07	04
25	10	67	34N43E07	04
153	10	11	34N43E18	04
155	10	35	34N43E16	04
].56	10	12	34N43E17	04
157	10	30	34N43E16	04
158	10	12	34N43E17	04
159	10	26	34N43E17	04
160	10	11	34N43E17	04
161	10	49	34N43E17	04
162	10	7	34N43E17	04
163	10	18	34N43E17	04
165	10	14	34N43E18	04
166	10	29	34N43E18	04
167	10	10	34N43E18	04
168	10	45	34N43E18	04
169	10	52	34N43E18	04
170	10	52	34N43E18	04
171	10	23	34N43E18	04
172	10	14	34N43E18	04
173	10	17	34N43E18	04
174	10	52	34N43E18	04
175	10	24	34N43E17	04
176	10	25	34N43E17	04
]_77	10	47	34N43E17	04
178	10	15	34N43E17	04
179	10	6	34N43E17	04
180	10	47	34N43E16	04
182	10	24	34N43E16	04
1.83	10	42	34N43E17	04
184	10	25	34N43E17	04
185	10	8	34N43E17	04
186	10	35	34N43E17	04
187	10	38	34N43E19	04
188	10	43	34N43E19	04
189	10	7	34N43E19	04
190	10	42	34N43E19	04
191	10	35	34N43E19	04
192	10	69	34N43E19	04
193	10	57	34N43E19	04
194	10	21	34N43E20	04

195	10	54	34N43E20	04
196	10	39	34N43E17	04
197	10	9	34N43E17	04

10 FORESTED

STA	TY	ACRES	LEGAL	OW
198	10	11	34N43E17	04
199	10	10	34N43E17	04
200	10	80	34N43E16	04
201	10	18	34N43E16	04
202	10	5	34N43E21	04
203	10	7	34N43E21	04
204	10	20	34N43E21	04
205	10	13	34N43E21	04
206	10	13	34N43E21	04
207	10	33	34N43E21	04
208	10	47	34N43E21	04
209	10	27	34N43E21	04
210	10	30	34N43E21	04
211	10	7	34N43E21	04
212	10	21	34N43E21	04
213	10	26	34N43E21	04
214	10	24	34N43E21	04
215	10	37	34N43E21	04
217	10	40	34N43E21	04
218	10	30	34N43E21	04
219	10	25	34N43E21	04
220	10	30	34N43E20	04
221	10	27	34N43E20	04
222	10	21	34N43E20	04
223	10	20	34N43E20	04
224	10	18	34N43E20	04
225	10	24	34N43E20	04
226	10	52	34N43E20	04
227	10	29	34N43E20	04
228	10	62	34N43E20	04
230	10	37	34N43E21	04
231	10	30	34N43E20	04
232	10	18	34N43E20	04
233	10	14	34N43E20	04
234	10	22	34N43E20	04
235	10	25	34N43E20	04
236	10	42	34N43E20	04
237	10	19	34N43E20	04
238	10	52	34N43E29	04
239	10	98	34N43E29	04
240	10	13	34N43E29	04
241	10	30	34N43E29	04
242	10	15	34N43E28	04
243	10	27	34N43E28	04
244	10	14	34N43E28	04
245	10	26	34N43E28	04
246	10	33	34N43E28	04

247	10	36	34N43E28	04
249	10	12	34N43E28	04
250	10	12	34N43E29	04

10 FORESTED

STA	TY	ACRES	LEGAL	OW
251	10	25	34N43E28	04
252	10	26	34N43E28	04
253	10	36	34N43E28	04
254	10	40	34N43E28	04
255	10	10	34N43E28	04
256	10	15	34N43E28	04
258	10	35	34N43E28	04
259	10	27	34N43E28	04
260	10	16	34N43E28	04
261	10	5	34N43E28	04
262	10	30	34N43E28	04
263	10	10	34N43E28	04
264	10	18	34N43E28	04
265	10	17	34N43E28	04
266	10	17	34N43E28	04
267	10	10	34N43E28	04
268	10	8	34N43E28	04
269	10	16	34N43E28	04
270	10	22	34N43E28	04
271	10	20	34N43E28	04
272	10	24	34N43E28	04
273	10	17	34N43E27	04
274	10	22	34N43E22	04
275	10	11	34N43E22	04
276	10	28	34N43E27	04
277	10	11	34N43E22	04
278	10	8	34N43E22	O4
279	10	10	34N43E21	04
280	10	17	34N43E21	04
281	10	14	34N43E21	04
282	10	14	34N43E21	04
283	10	7	34N43E21	04
284	10	65	34N43E21	04
285	10	5	34N43E21	04
286	10	45	34N43E34	04
287	10	57	34N43E34	04
288	10	45	34N43E34	04
289	10	76	34N43E34	04
290	10	48	34N43E34	04
291	10	47	34N43E34	04
292	10	35	34N43E34	04
293	10	11	34N43E34	04
294	10	14	34N43E22	04
296	10	16	34N43E34	04
297	10	12	34N43E34	04
298	10	32	34N43E22	04
299	10	33	34N43E22	04

1300	10	45	34N43E21	04
;301	10	30	34N43E16	04
302	10	41	34N43E15	04

10 FORESTED

STA	TY	ACRES	LEGAL	OW
1303	10	24	34N43E15	04
304	10	9	34N43E15	04
305	10	13	34N43E15	04
306	10	37	34N43E10	04
307	10	18	34N43E10	04
308	10	40	34N43E09	04
309	10	48	34N43E09	04
310	10	5	34N43E09	04
311	10	116	34N43E09	04
312	10	12	34N43E10	04
313	10	13	34N43E10	04
314	10	21	34N42E10	04
315	10	70	34N42E10	04
316	10	42	34N42E10	04
317	10	18	34N42E10	04
318	10	29	34N42E10	04
319	10	13	34N43E22	04
320	10	12	34N43E22	04
321	10	15	34N43E22	04
322	10	28	34N43E22	04
323	10	25	34N43E22	04
324	10	16	34N43E22	04
325	10	13	34N43E22	04
326	10	21	34N’42E10	04
327	10	13	34N42E10	04
328	10	37	34N42E10	04
329	10	].2	34N42E10	04
330	10	20	34N42E10	04
331	10	46	34N42E10	04
332	10	45	34N42E10	04
333	10	76	34N42E10	04
334	10	76	34N42E10	04
335	10	40	34N42E10	04
336	10	19	34N42E14	04
337	10	24	34N42E14	04
338	10	36	34N42E14	04
339	10	60	34N42E14	04
340	10	18	34N42E14	04
341	10	120	34N42E14	04
342	10	98	35N42E34	04
343	10	94	35N42E34	04
344	10	98	35N42E28	04
345	10	75	34N42E04	04
346	10	44	34N42E04	04
347	10	49	34N42E04	04
348	10	83	34N42E08	04
349	10	210	34N42E08	04

350	10	83	34N42E08	04
351	10	28	35N42E32	04
352	10	23	35N42E32	04

10 FORESTED

STA	TY	ACRES	LEGAL	OW
353	10	56	35N42E32	04
354	10	56	35N42E32	04
355	10	40	35N42E32	04
356	10	25	35N42E32	04
357	10	32	35N42E27	04
358	10	50	35N42E27	04
;359	10	79	35N42E27	04
;360	10	51	35N42E27	04
361	10	38	35N42E27	04
362	10	90	35N42E27	04
363	10	30	35N42E27	04
364	10	225	35N42E23	04
365	10	35	35N42E26	04
366	10	34	35N42E26	04
367	10	60	35N42E26	04
368	10	15	35N42E26	04
369	10	78	35N42E25	04
370	10	17	35N42E25	04
371	10	33	35N42E25	04
372	10	12	35N42E25	04
373	10	10	35N42E25	04
374	10	56	35N42E25	04
375	10	22	35N42E25	04
376	10	57	35N42E25	04
377	10	ill	35N42E25	04
378	10	JL9	35N42E25	04
379	10	75	35N42E25	04
380	10	20	35N42E25	04
381	10	135	35N42E24	04
382	10	13	35N42E26	04
383	10	57	35N42E26	04
384	10	11	35N42E23	04
385	10	125	35N42E24	04
386	10	]_0	35N42E24	04
387	10	50	35N42E24	04
388	10	].3	35N42E24	04
389	10	50	35N42E23	04
390	10	26	35N42E23	04
391	10	60	35N42E23	04
392	10	9	35N42E23	04
393	10	34	35N42E23	04
394	10	26	35N42E23	04
395	10	8	35N42E23	04
396	10	12	35N42E23	04
397	10	45	35N42E23	04
398	10	32	35N42E23	04
399	10	75	35N42E23	04

400	10	53	35N42E23	04
401	10	40	35N42E26	04
402	10	8	34N42E15	08

10 FORESTED

STA	TY	ACRES	LEGAL	OW
406	10	84	34N43E35	15
407	10	80	34N43E35	15
408	10	15	34N43E35	15
409	10	730	34N43E35	15
411	10	458	34N43E27	15
412	10	6	34N43E35	15
413	10	16	34N43E34	15
414	10	30	34N43E27	15
416	10	1170	34N43E22	15
418	10	205	34N43E27	15
419	10	290	34N42E13	15
420	10	130	34N42E13	04
421	10	183	34N42E13	04
422	10	15	34N42E14	04
424	10	38	34N42Ell	04
425	10	417	34N42Ell	O8
426	10	103	34N42Ell	O8
427	10	4	34N42Ell	O8
428	10	630	34N42E03	O8
429	10	4080	35N42E35	04
430	10	90	34N42E03	08
431	10	112	34N42E33	08
432	10	24	34N42E33	08
433	10	1′70	34N42E33	O8
434	10	80	34N42E05	O8
435	10	18	35N42E33	08
436	10	143	35N42E33	08
437	10	10	35N42E33	08
438	10	102	35N42E32	04
439	10	1138	35N42E32	04
440	10	26	35N42E32	04
441	10	2	35N42E32	04
442	10	488	34N42E05	O8
443	10	140	34N42E05	08
444	10	93	34N42E05	08
445	10	25	34N42E06	04
446	10	13	34N42E06	04
447	10	235	34N42E08	O4
448	10	28	34N42E08	O4
449	10	540	34N42E09	O8
450	10	100	34N42E17	08
451	10	102	34N42E17	08
452	10	273	34N42E16	08
453	10	40	34N42E21	08
454	10	9	34N42E22	O4
455	10	472	34N42E15	08
456	10	212	34N42E16	08

457	10	86	**34N42E04**	**04**
458	10	10	**34N42E04**	**04**
459	10	21	**34N42E04**	**04**

10 FORESTED

STA	TY	ACRES	LEGAL	OW
460	10	270	34N42E04	04
461	10	71	34N42E04	04
462	10	48	34N42E04	04
463	10	83	34N42E09	08
464	10	97	34N42E08	04
465	10	160	34N43E33	15
466	10	38	35N42E36	04
26	10	40	34N43E18	04
27	10	30	34N43E20	04
28	10	8	34N43E17	04
29	10	10	34N43E08	04
30	10	16	34N43E09	04
31	10	24	34N43E09	04
32	10	6	34N43E09	04
33	10	276	34N43E09	04
34	10	52	34N43E09	04
35	10	40	34N43E09	04
36	10	16	34N43E09	04
37	10	30	34N43E09	04
38	10	17	34N43E09	04
39	10	12	34N43E09	04
40	10	69	34N43E04	04
41	10	109	34N43E04	04
43	10	81	34N43E04	04
44	10	29	34N43E05	04
45	10	24	34N43E05	04
46	10	14	34N43E05	04
47	10	26	34N43E04	04
48	10	45	35N43E33	04
49	10	53	34N43E05	04
50	10	]_4	34N43E05	04
51	10	95	34N43E05	04
52	10	18	34N43E06	04
53	10	34	34N43E06	04
54	10	60	35N43E32	04
55	10	105	35N43E32	04
56	10	63	35N43E32	04
57	10	11	35N43E32	04
58	10	24	35N43E32	04
59	10	21	35N43E32	04
60	10	12	35N43E32	O4
61	10	5	35N43E32	04
62	10	320	35N43E31	04
63	10	5	35N43E31	04
64	10	5	35N43E31	04
65	10	50	35N43E31	04
66	10	5	35N43E31	04

67	10	22	35N43E31	04
68	10	42	35N43E31	04
69	10	160	35N43E31	04

10 FORESTED

STA	TY	ACRES	LEGAL	OW
70	10	9	35N43E32	04
71	10	104	34N42E36	04
72	10	40	34N42E36	04
73	10	60	34N42E36	04
74	10	65	34N42E36	04
75	10	27	34N42E36	04
76	10	160	34N42E26	04
77	10	12	34N42E31	04
78	10	29	34N42E01	04
79	10	33	34N42E01	04
80	10	53	34N42EO1	04
81	10	20	34N42E01	04
82	10	52	34N42E01	04
83	10	90	34N42E01	04
84	10	100	34N43E06	04
85	10	45	34N43E06	04
87	10	55	34N43E06	04
88	10	32	34N43E06	04
89	10	35	34N43E06	04
91	10	9	34N43E06	04
92	10	20	34N43E06	04
93	10	59	34N43E06	04
94	10	62	34N43E07	O4
95	10	48	34N43E07	04
96	10	40	34N43E07	04
97	10	41	34N43E06	O4
98	10	23	34N43E06	O4
99	10	62	34N43E06	O4
100	10	34	34N43E06	O4
101	10	29	34N42E01	O4
102	10	10	34N42EO1	04
103	10	32	34N42E01	O4
104	10	36	34N43E06	04
].07	10	90	34N43E05	O4
108	10	35	34N43E08	O4
109	10	14	34N43E08	O4
111	10	32	34N43E08	04
112	10	39	34N43E07	04
1.13	10	59	34N43E07	O4
114	10	47	34N43E07	O4
116	10	14	34N43E08	O4
1117	10	41	34N43E08	04
118	10	10	34N43E08	O4
119	10	8	34N43E07	O4
120	10	12	34N43E08	O4
121	10	50	34N43E08	O4
124	10	32	34N43E08	O4

125	10	54	34N43E08	04
126	10	102	34N43E07	04
127	10	42	34N43E07	04

10 FORESTED

STA	TY	ACRES	LEGAL	OW
128	10	43	34N42E12	04
129	10	20	34N43E08	04
130	10	35	34N43E08	04
132	10	68	34N43E08	04
134	10	20	34N43E08	04
135	10	1.4	34N43E08	04
136	10	6	34N43E08	04
138	10	18	34N43E17	04
139	10	24	34N43E17	04
140	10	15	34N43E17	04
141	10	30	34N43E18	04
142	10	46	34N43E17	04
143	10	11	34N43E17	04
145	10	22	34N43E18	04
147	10	102	34N43E18	04
1.48	10	15	34N43E18	04
150	10	52	34N43E18	04
151	10	44	34N43E07	04
152	10	18	34N43E07	04
469	10	40	34N42E16	08
471	10	8	34N42E14	04
472	10	11	34N43E29	04
4'74	10	16	34N43E05	04
4'75	10	23	35N42E36	04
476	10	4	34N42E04	04
TOTAL		27937		

12 POWER LINES

STA	TY	ACRES	LEGAL	OW
410	12	25	34N43E26	15
TOTAL		25		

20 WETLANDS

STA	TY	ACRES	LEGAL	OW
154	20	16	34N43E17	04
164	20	11	34N43E18	04
181	20	17	34N43E16	04
216	20	28	34N43E21	04
229	20	6	34N43E20	04

248	20	9	34N43E28	04
295	20	25	34N43E22	04
405	20	27	34N43E01	15
417	20	2	34N43E22	15
423	20	21	34N42E14	O4
467	20	15	35N42E35	04
468	20	3	35N42E35	04
86	20	3	34N43E06	04

20 WETLANDS

STA	TY	ACRES	LEGAL	OW
105	20	6	34N43E05	O4
106	20	21	34N43E05	04
137	20	16	34N43E08	04
144	20	14	34N43E18	04
473	20	2	35N42E36	04
TOTAL		242		

22 LAKES AND PONDS

STA	TY	ACRES	LEGAL	OW
415	22	4	34N43E34	15
].15	22	16	34N43E07	04
TOTAL		20		

TOTAL ACRES IN WATERSHED 28530